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FEBRUARY 1952

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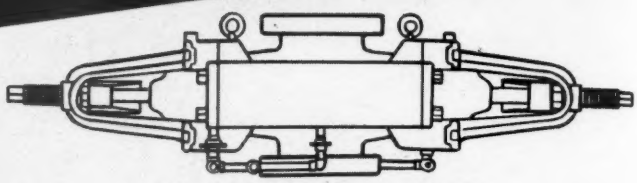
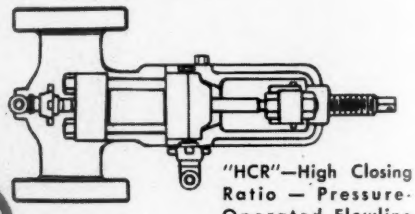
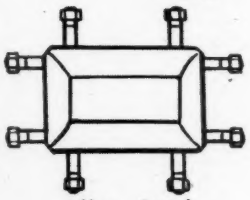


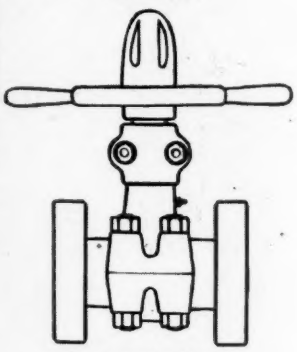
"QRC" — Quick Ram Change — Pressure-Operated Blowout Preventer.



"HCR"—High Closing Ratio — Pressure-Operated Flowline Valve.

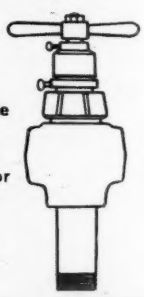


Alloy Steel Mud Cross.



Flex-Seal Mud Valve.

Mud Line Pressure Gauge.



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the Course of OIL

THE COST OF STEEL

STEEL today is the cheapest of all the basic materials upon which American industry, particularly the petroleum industry, must rely. Steel sells at an average price of about five and a half cents a pound, and is one of the few things left in this land that a nickel will still buy.

Pound for pound, it is cheaper than any non-ferrous metal, wood, or paper, than any material from which clothing is made, and than practically any item of food. Yet it takes hundreds of thousands of men, hundreds of millions of dollars worth of materials, and billions of dollars worth of plants, machines, and facilities to turn out the steel we produce each year.

Because many products for military or civilian use are made largely of steel, the erroneous belief persists, however, that the price of steel is a major factor in the cost of the finished article.

The cost of steel is actually only a small fraction of the price of any finished product. Even in things that are made almost entirely from steel—things like battleships, tanks, automobiles, and bridges, the cost of steel that goes into them is less than one-tenth of the final cost of the completed project.

The steel companies of the United States are now engaged in the greatest program of expansion ever undertaken at any time by any such industry in the world. Their expenditure for replacements, improvement, and expansion are estimated at $1,200,000,000 in 1951 and the outlay for these purposes will be even greater in 1952. Production of steel in 1951 set a new all-time record of 105,500,000 tons. This was nearly 16,000,000 tons more than the peak annual output of 89,600,000 tons during World War II. Despite the record production and sales, profits actually declined in 1951. The industry's rate of profits on sales in 1951 fell to a new low for the past five years of record high operations.

Comparing the first nine months of 1951 with the similar period in 1950, it was found that the steel industry shipped 9.2 per cent more steel; that its payroll costs alone went up 23 per cent; that it will have to pay the federal government 95 per cent more in taxes. Yet, the net profits after taxes of 18 companies representing 88 per cent of total ingot production, went down 20 per cent.

Although the cost of steel as such represents less than a tenth of the selling price of the average manufactured product, labor costs—accumulated along the nation's production and distribution lines—represent something like three-quarters of the final price.

The foregoing are among the salient facts set forth by the steel industry before a panel of the wage stabilization board of the United States in Washington.

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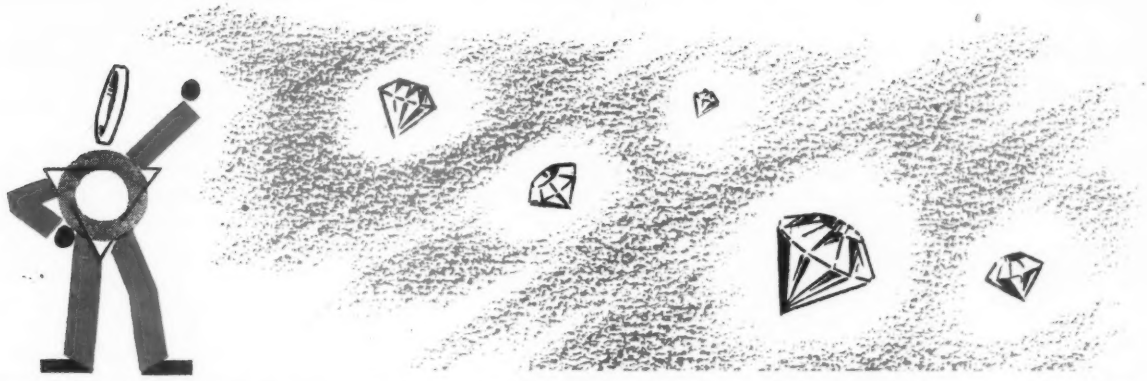

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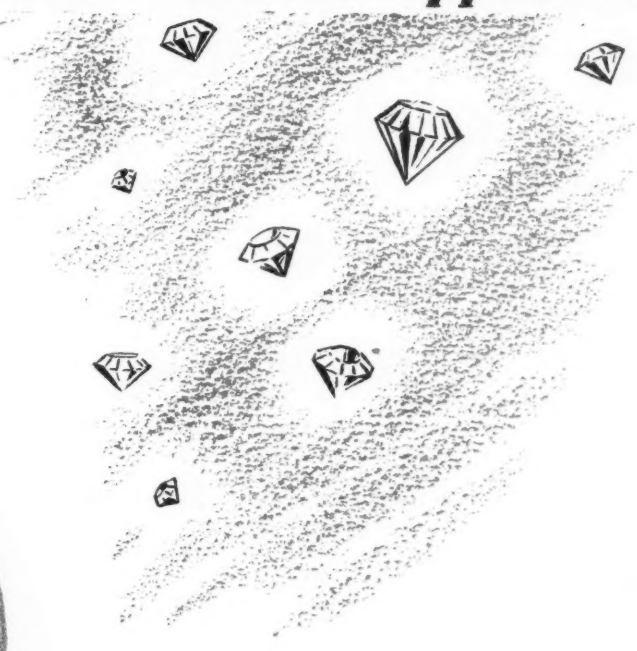

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With The EDITORS . . . . . .

A Dog-Fight "In Alcohol"?

With various petrochemical plants forging ahead on construction schedules, along with alcohol from fermentation and non-petroleum sources and with three or more primary alcohol producers slated to go on stream within 12-18 months, the apparent prospects for a price war and a glutted industrial alcohol market seem to better than probable. Carthage Hydrocol at Brownsville is laboring mightily to get into full production with its 7000 bbl per day output of synthetic hydrocarbons from natural gas, and with expected yields of organic oxygenated chemicals including ethyl alcohol running into almost astronomical figures, the life of an alcohol manufacturer looks to be no bed of roses by 1955 or thereabouts. Excluding beverage alcohol for the time on the possible basis of undesirable flavor of synthetic alcohol, traceable to its "ancestry", a quick glance indicates the likelihood of a superabundance of C_2H_5OH, with seriously diminishing returns to all producers. At least one thing this situation may clarify—it may well show how much or how little of the cost load for synthetic fuels can be carried by these chemicals formed as byproducts of hydrocarbon synthesis. —A. L. F.

State of the Gas Industry

There is nothing in the report made at the start of the year by George F. Mitchell, president, American Gas Association, to cast gloom over the gas industry. It is a bright picture, as a matter of fact, that he paints in pointing out the accomplishments that were made in 1951 and the prospects for further accomplishments in the present year.

Nearly $1.5 billion were allocated by gas utilities for new plant and equipment in 1951. Of this total approximately $1 billion went into the construction of new natural gas transmission systems and expansion of existing systems. Moreover, this huge expansion program was short of meeting consumer demand. Despite the fact that 25,392,000 customers were being served by gas utilities at the end of 1951, many thousands are on waiting lists in some areas.

The gas industry has allocated $1.3 billion for new construction this year. The Federal Power Commission authorized construction of more than 12,000 miles of pipe line in 1951, and applications were pending for about an equal mileage at the year end. Such large expenditures for natural gas transmission facilities, of course, must be predicated on sufficient reserves. Thus it is of importance to note that the Natural Gas Reserves Committee of the American Gas Association estimated that at the end of 1950 the proved recoverable reserves of natural gas in the United States totaled 185.6 trillion cubic feet, an increase of more than 5 trillion cubic feet over the previous year despite withdrawals of 6.9 trillion cubic feet during 1950. In fact, reserves have shown a gain each year for some time.

Numerous factors point to a continuation of the industry's advances in 1952, according to Mitchell. Consumer demand still exceeds the industry's capacity to serve. Increased defense production will create additional demand for industrial gas. Approximately 800,000 new home units are scheduled for the year, and the gas industry expects to obtain its fair share of this market.

Steel shortages, manpower problems, higher taxes, greater state and federal controls, and other matters beyond the control of the industry, may alter this outlook to some extent. Despite such possibilities, however, it is Mitchell's considered opinion that the outlook for the gas industry in 1952 is most favorable.—F. H. L.

The Sun A Synthesis Furnace?

Now University of Michigan scientists, working with a new infrared spectrometer, confirms the older theory that carbon monoxide, CO, exists in quantity in the gases and vapors on the sun. In fact, it is reported that 40 times as much carbon monoxide occurs on the sun as any other compound or molecule. Origin of the monoxide, or of its components on the sun is not explained except to say, by inference, "it's there". Now, a highly reactive Fischer-Tropsch synthesis might be possible by combining the monoxide with the hydrogen in the sun's atmosphere, except for the probability that at the temperature of the sun's surface the reaction could not go to completion or the products, or even the reactants themselves, would be completely disassociated, unable to exist as such!—A. L. F.

A. L. Forbes, Jr.

The untimely death of A. L. Forbes, Jr., president of Associated Pipe Line Contractors, Inc., Houston, Texas, has left members of the pipe line industry with a great feeling of sadness and personal loss. Though but 53 years of age, he had been associated with the industry over a period of 30 years, first with operating companies then as a contractor. During that time he had made and held a host of friends. His popularity among the members of his craft is attested by the fact that the day prior to his death he had been elected president of the Pipe Line Contractors Association. If anyone had an unkind word say about A. L. Forbes, Jr., it failed to reach our ears.—F. H. L.

Cracking Catalysts Go Abroad—

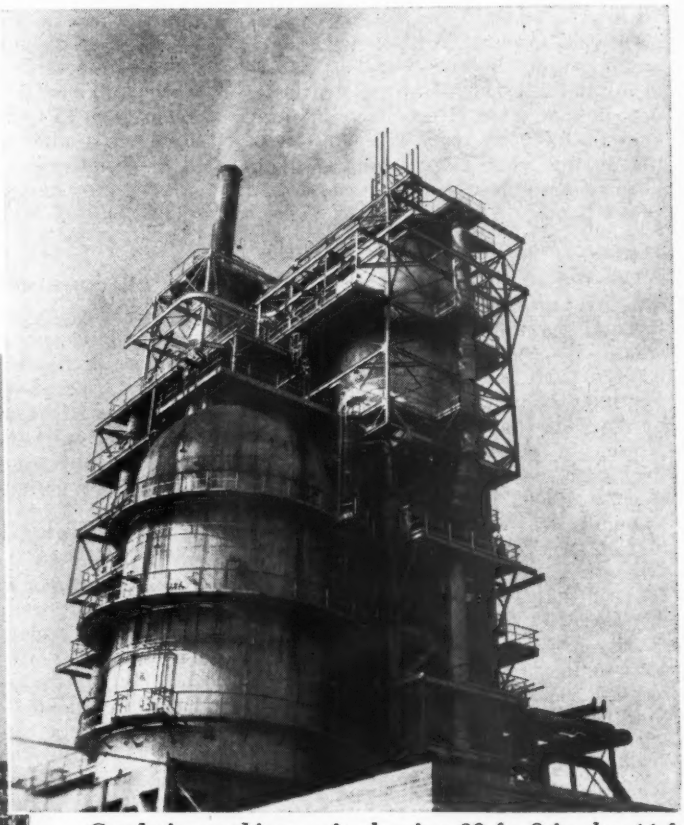
Europe is building refineries galore—many with American funds—to satisfy home markets, and save dollars; refineries needs cracking catalysts, etc. The canny Dutch firm, translated being Royal Sulfuric Acid Company, Amsterdam, contracts with American Cyanamid to make all the latter company's catalysts under license, 'cats' to be sold in western continental Europe. And we can remember when chemical processes and licenses, travelled the opposite direction to Yankeeland!—A. L. F.

HORTON PROCESSING EQUIPMENT

MEETING THE CHALLENGE OF INCREASED PRODUCTION

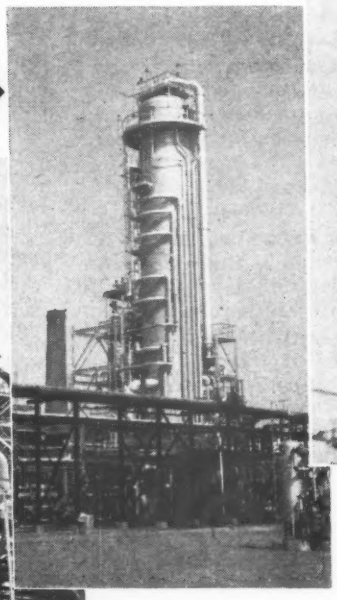
For years, Horton processing equipment has helped the petroleum industry keep pace with the ever growing demand for its products. Now, when the record of higher and higher productivity is receiving its greatest test—Horton equipment is still meeting the challenge.

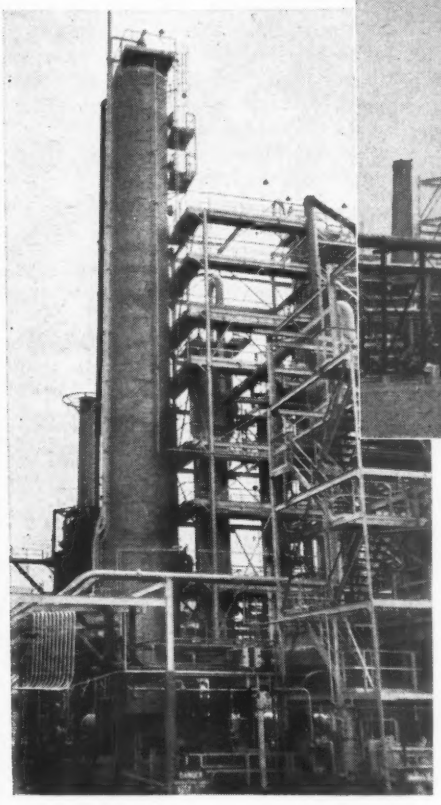
These Horton units were erected to help *double* the capacity of a large midwest refinery. Each was carefully engineered and fabricated to meet exacting specifications embodying the most modern refinery principles, to assure accurate, efficient petroleum processing. Write for information and quotations.



Catalytic cracking unit showing 30-ft. 8-in. by 44-ft. regenerator and 26-ft. and 23-ft. 6-in. by 43-ft. reactor.

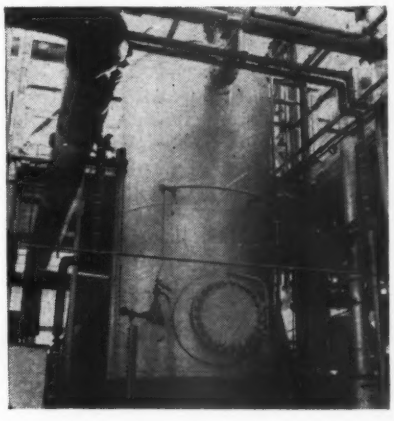
15-ft. diam. by 90-ft. vacuum tower built by Chicago Bridge and Iron Company.





12-ft. diam. by 120-ft. extractor tower installed in the furfural extraction unit. It was shipped all in one piece from our Chicago plant and weighed 100 tons.

6-ft. diam. by 19-ft. 4-in. absorber gas knockout drum. It was designed for a working pressure of 190 lbs. per sq. in. and random x-rayed at our Chicago plant.



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Boston 10.....1028—201 Devonshire St.	Houston 2.....2137 C & I Life Bldg.	Seattle 1.....1329 Henry Bldg.
Chicago 4.....2481 McCormick Bldg.	Los Angeles 17..1546 General Petroleum Bldg.	Tulsa 3.....1634 Hunt Bldg.
Cleveland 15.....2251 Guildhall Bldg.	New York 6.....3373—165 Broadway Bldg.	Washington 6, D. C.....1136 Cafritz Bldg.

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HIGHLIGHTS IN OILDOM

TEXAS OUTPUT HITS BILLION BARRELS

For the first time in its history, Texas hit the billion-barrel-year mark last year. A total of 1,106,358,084 bbl of petroleum were taken from the ground in 1951, which includes 978,010,000 bbl of oil and 128,348,004 bbl of hydrocarbon liquids. First Texas records were kept in 1896, 55 years ago, and show that in that year Texas produced 1000 bbl of oil—quite a difference from last year's figure.

CANADA FINDS HIT NEW HIGH IN 1951

Gas and oil discoveries totaled 108 in Western Canada last year, a new record for that country. Oil strikes totaled 40 and gas discoveries 68. More than $200,000,000 were put into western oil and gas exploration, development, and land, by the more than 200 oil companies interested in the area. Alberta was in the lead with 98 finds, including 35 oil strikes, and 63 gas discoveries. British Columbia had a gas discovery and its first oil strike. Saskatchewan had a pair of heavy oil strikes and three gas finds. In 1950 there were only 10 wildcat oil discoveries in Alberta. That year's total of 35 gas strikes was almost doubled by 1951 exploration. Best single discovery of 1951 was the Wizard Lake oil sector southwest of the Leduc field, which opened the west's new oil era in 1947. Oil reserves total 100,000,000 bbl in this area, and it is expected major rating will be given along with the Redwater, Leduc, and Turner Valley fields.

DEPLETION ALLOWANCE WATCHED

President Truman has asked Congress to revise the depletion allowance for oil and gas production to take out the "loopholes and special privileges" as a part of his legislation program affecting the oil industry. The oil industry, however, does not expect this session to do anything about the allowance, which permits a charge-off for income tax purposes, of 27½ per cent of oil and gas income.

WILSON DEFENDS BIG COMPANIES

In his defense of big oil companies, Dr. Robert E. Wilson, chairman of the board of Standard Oil (Indiana) gave the following facts:

1. A single pipe line now proposed to extend only 780 miles involves an investment of $100,000,000. The total length of crude and product trunk pipe lines in this country as of January 1, 1950, was approximately 92,000 miles.

2. A refinery large enough to be reasonably efficient, running about 30,000 bbl of crude oil per day and making the usual products, now costs about $40,000,000. Such refineries are small compared with total U. S. refinery capacity of more than 7,000,000 bbl per day.

OKLAHOMA FEARS FUEL SHORTAGE

Oklahoma is worrying about a fuel shortage again this year. Last year its problem was natural gas, but this year the trouble is a liquefied petroleum gas shortage. Governor Johnston Murray has been petitioned by dealers to place an embargo on LPG shipments out of state. In the first nine months of last year, LPG producers delivered 136,152,853 gal to state consumers, and shipped 63,873,107 gal in interstate commerce. (See Page A-71.)

U S. OIL CONSUMPTION AT NEW HIGH

Sun Oil Company has reported that the total consumption of petroleum products in the United States for the first time exceeded 100 billion gallons in one year. This is equivalent to 2 gal per day per man, woman, and child, and compares with approximately a half a pint per day per person for the rest of the world.

GULF DENIES CARTEL CHARGE

Attorney Elmer Patman's charge that Gulf Oil Corporation is involved in a cartel arrangement with four other oil companies has met with strong denials from Gulf. Patman attended the third World Petroleum Congress as an observer for the government. Chairman of Gulf, J. F. Drake and S. A. Swensrud, president, issued a statement declaring that if the newspapers' account of the accusations is correct, the report is not based upon fact. It added, "Gulf is not a party to any cartel arrangement either international or otherwise; neither is it a party to any other agreement, arrangement, plan, or program with any other oil company or companies either in this country or abroad that seeks to develop or control price structures of allocation of markets."

INTERNATIONAL OIL SHOW FOR 1953

Plans are underway for the 1953 oil show. Announcement of the committee was made by W. G. Skelly, president of the International Petroleum Exposition. The show will be held May 14 to 23, 1953 at Tulsa, Oklahoma. William B. Way of Tulsa is general manager.

RUSSIA REPORTS OIL GOAL REACHED

Russia has reported that its 1951 oil production goal was reached three days ahead of schedule. The oil industry minister of Russia reported to Prime Minister Stalin that the production schedule for crude and refined oil, light oil products, and for lubricating oil had been completed.

No definite estimate can be made of Soviet oil production in 1951 but Western embassy economic experts believe it is more than 40,000,000 tons.

U. S. OIL OUTPUT HITS NEW PEAK

The volume of national output increased by about 8 per cent in 1951 as compared with 1950, and was higher than any other year, the U. S. Department of Commerce has reported. The value of output of final goods and services — the gross national product — totaled $327 billion, 15 per cent more than in 1950. Roughly, half this rise represented higher prices, and the remainder the increase in volume.

U. S. TAXPAYERS CALLED VICTIMS

The American taxpayer is the real victim of the Iran-British conflict. This is the contention of Dr. Matine-Daftary, son-in-law of Premier Mohammed Mossadegh and former prime minister of Iran. The Iranian senator and prime minister, who recently completed a 2½ month stay in the U. S., told the press. "Britain is certainly not the loser. She is getting both the oil and the dollars she needs from the United States, oil and dollars which American taxpayers are providing." He added that it was the hope of the Iranian countrymen to settle the oil question, but declared ". . . by its settlement Britain and America have to gain more than Iran."

SHORTAGE OF SCIENTISTS STUDIED

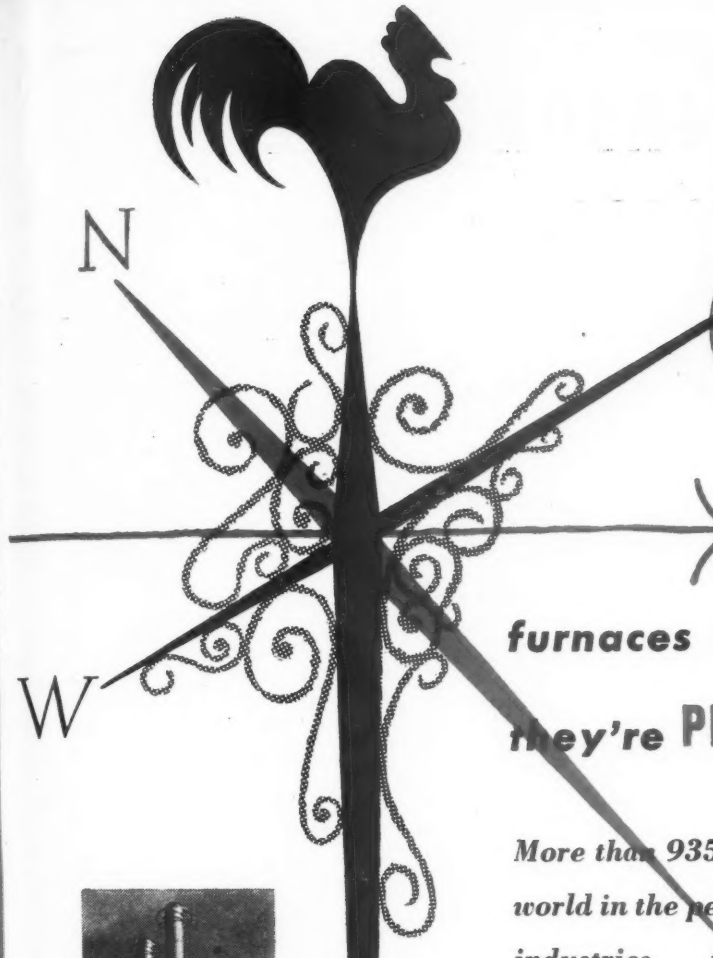
Ways to overcome this country's acute shortage of scientific manpower are suggested in a series of studies, prepared for the Navy on how to improve the selection, training, and utilization of engineers and scientists. These studies are now available to the public, the Office of Technical Services, U. S. Department of Commerce has announced.

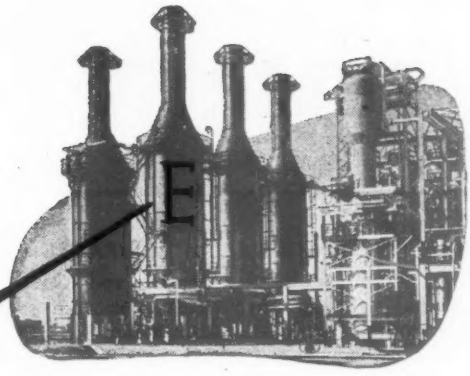
NBS CELEBRATES 50TH YEAR

The National Bureau of Standards recently celebrated its 50th anniversary. It was honored on the occasion at the American Standards Association's annual meeting in New York City. A scroll congratulating the Bureau "on a half-century of service in the public interest and in the improvement of the standard of American life", was presented to Dr. A. V. Astin, NBS acting director.

PRATT HAS FAITH IN U.S. ABILITY

Holding a bright hope of America's ability to meet any problem thrown its way in the future, Wallace E. Pratt, leading geologist, has stated his belief that until America depletes its "resourcefulness" its future is secure. He added, "It is futile to try to predict what free man will be able to accomplish as technology begins to evolve. It can't be done. What we know of the difficulties we face make us blind to the potentialities of our future achievement in any direction."





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furnaces like these, you can be sure they're* PETRO-CHEM ISO-FLOW *design

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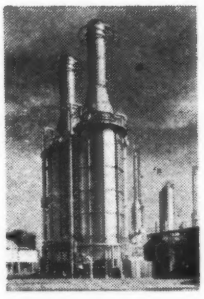

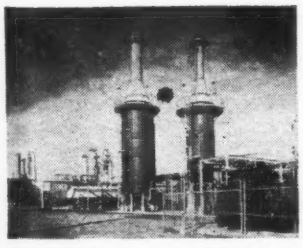

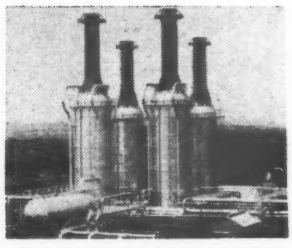

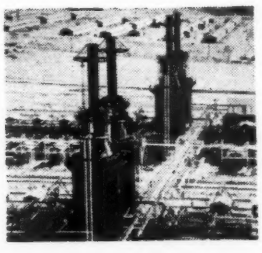

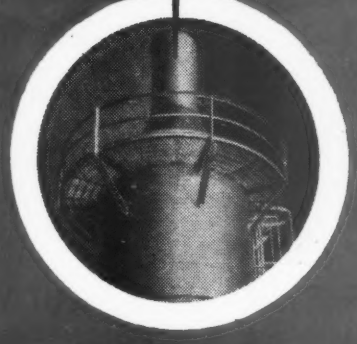

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To obtain more information on products advertised see page E-41

PETROLIC PERSONALITIES

DICK SNEDDON

DOUG GRAHAM HOSTS ITALIAN MANUFACTURER

Doug Graham, the estimable prexy of Dunlap and Graham, drilling contractors, has recently been acting as personal escort to Signor Mario Massarenti, factory manager of the Massarenti Manufacturing Works at Piacenza in the Italian Po Valley. This assignment has been far from an imposition for Doug since the Signor Massarenti is an interesting travel companion with a lot of exciting experience and a lucid and extensive vocabulary with which to expound. A short time ago he broadcast the story of American oil and the free enterprise system to Italy in his native language and, we are told, did a very nice job of it. He is a graduate engineer from the University of Milan with some post graduate work at Cambridge and is well equipped to analyze conditions here and interpret them for the benefit of his own countrymen.

It might be explained that the Massarenti Manufacturing Works is a fully up-to-date organization, manufacturing complete drilling rigs capable of penetration to depths of 15,000 ft and including derrick, drawworks, pumps, and all the essential elements. The Po Valley at the present time boasts some 20 active drilling rigs, five of which only are American manufactured and operated. So far a few gas wells have been completed but there has been no oil discovery. There is hope, however, that oil may soon be found and no effort is being spared to bring that about. Signor Massarenti is a pleasant individual, equipped with all the graces, and has made a very favorable impression on the oil men that he has contacted. Indeed, it would be difficult for Italy to select a more fitting ambassador to send to this country.

PEDRETTI HOSTS CHILEAN QUINTET

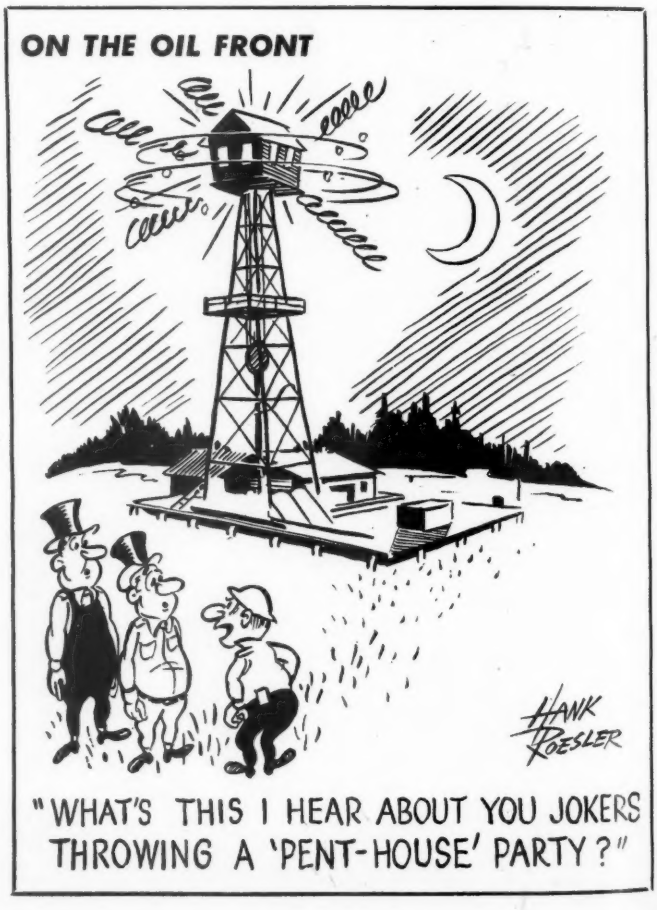
At a recent Nomad meeting in Los Angeles we were introduced by Juan Pedretti, the affable Union Oiler, to a quintet of good looking young Chileans who are in this country to enhance their general education and at the same time to garner some experience in our exploration and production techniques. They are Mario Infante, Arnaldo Rojas, Oscar Schneider, Salvada Ferradas, and Robert Blackwood, and they were sent here by Empresa Nacional del Petroleo de Chile, of which they were all employees. Bob Blackwood is already employed as a foreman by Union Oil Company, and the other four boys are taking specialized studies at local colleges to prepare themselves for subsequent training in various responsible positions. Arnaldo Rojas is studying petroleum engineering at the University of Southern California; Mario Infante is learning about porosities, permeabilities, and the other properties with which the core lab analyst must be familiar. He is also at U. S. C. So is Salvada Ferradas, who hopes to become a reservoir engineer. Oscar Schneider is at Cal Tech familiarizing himself with the equipment and methods of the geophysicist. When the boys have completed their college courses they will receive practical experience as employees of Union Oil Company, and will eventually return to Chile to take their respective places in the national petroleum program.

DRILLING IN SUB-ZERO TEMPERATURES

Out of Fairbanks, Alaska, by dog sled comes news of Arctic Contractors and their continuing struggle to acclimate men and machines to the rigors of existence in the land of the deep freeze. Gene Davis, the popular Santa Marian, who is project manager for the civilian contractors, tells us that despite the natural handicaps, 15 wells were drilled in 1951; but this year plans call for less drilling and more exploratory work. Geological operations are under the direction of Cliff Mohr of Golden, Colorado, a graduate of Colorado University with a wide experience in Texas, the Rocky Mountain area, Argentina, Chile, Spain, and Portugal. Herb Dye, chief of drilling operations is from down California way where he spent a trifling 30 years or so learning the fundamentals of his art from such well known institutions as Taft Drilling Company and the Gene Reid Company, of which he was for a number of years drilling superintendent. Karl VonderAhe, chief petroleum engineer, was with Richfield Oil Corporation for about 20 years, and is thoroughly familiar with the black and gold outcrop at 555 South Flower Street, Los Angeles. Among the head drillers are Dave Briggs, Reno Micheletti, Chet Hollingsworth, and Ed West. The cement expert is Paul Lewis, and Joe Cassick is the warehouseman. All of the fellows agree that the Alaska winter, although very severe, can be thoroughly enjoyable—especially if you happen to be a polar bear.

NEWS FROM THE NORTHWEST

From the Palliser Hotel in Calgary, Alberta, Bart Gillespie, the meandering Scot, writes to say that he is about to go up into the Peace River country on a reconnoitering jaunt, the which creates a distinct feeling of nostalgia. In our younger days we batted around that north country area and enjoyed it no end despite frequent encounters with pontoon-equipped mosquitoes as big as bumble bees, horse flies that must have been coached in the flying tackle by Knute Rockne, and tiny "no-see-um" bugs that nested possessively under our epidermis and were mighty difficult to dispossess. And speaking of Bart reminds us —it is being rumored around the Petroleum Club and other oil men's hangouts in Los Angeles that O. I. "Tork" Torkelsen, the invincible exponent of counter sports and high executive of British-American Oil Producing and Refining Company, is due in the western metropolis one of these days, and there hasn't been such a padlocking of wallets since the 1905 money panic.



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Cook discovered the many causes that promote ring breakage by extensive research in the field of practical operation which included electronically indicating most makes of engines. Of all ring types tested, Cook 124 ring proved its superiority time and again. It has eliminated ring breakage, and other problems in many leading Diesel plants. But write for the full story—learn why it will pay you to install Cook "job-engineered" piston rings.

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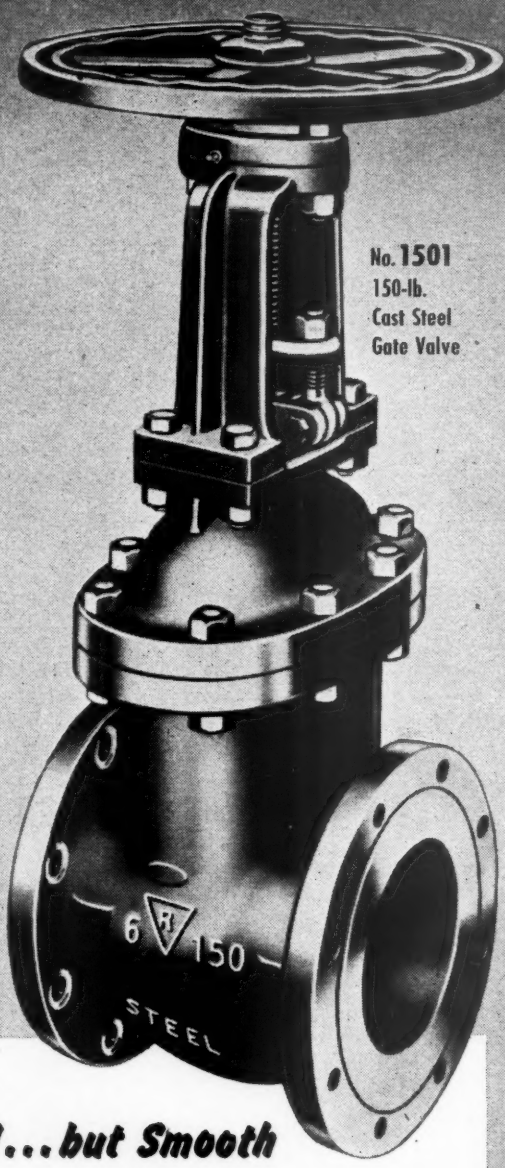

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MEETINGS

Feb. 18-20—**Oil Industry Information Committee,** Plaza Hotel, San Antonio, Texas.
Feb. 21—**Southern California Meter Association,** Rio Hondo Country Club, Downey.
Feb. 25—**Institute of Petroleum,** Manson House, 26, Portland Place, W. I., London.
Feb. 26-27—**Wisconsin Petroleum Association,** Milwaukee Auditorium, Milwaukee.
Feb. 27-29—Corrosion Short Course, **National Association of Corrosion Engineers,** Tulsa Chapter, Mayo Hotel, Tulsa, Oklahoma.
Feb. 28-29—**American Association of Petroleum Geologists,** Rocky Mountain section, Salt Lake City, Utah.
Feb. 29—**Natural Gasoline Association of America,** Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas.
March 3-7—**American Society for Testing Materials,** spring meeting and committee week, Hotel Statler, Cleveland, Ohio.
March 5-6—**Pacific Coast Gas Association,** Fresno, California.
March 5-7—**American Petroleum Institute,** division of production, Southwest district, Washington-Youree, Shreveport, Louisiana.
March 10-14—**National Association of Corrosion Engineers,** annual conference, Galveston Pleasure Pier and Buccaneer Hotel, Galveston, Texas.
March 11-14—**Plastics Exposition,** fifth national, Exposition Hall, Philadelphia, Penna.
March 12—**Institute of Petroleum,** Manson House, 26, Portland Place, W. I., London.
March 16-19—**American Institute of Chemical Engineers,** regional meeting, Biltmore Hotel, Atlanta, Georgia.
March 19-21—**American Petroleum Institute,** division of production, Mid-Continent district, Hotel Broadview, Wichita, Kansas.
March 22-April 6—**International Trade Fair,** Navy pier, Chicago, Illinois.
March 23-27—**American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists,** annual joint meeting, Biltmore Hotel, Los Angeles.
March 26—**Institute of Petroleum,** Manson House, 26, Portland Place, W. I., London.
March 27-28—**Texas Independent Producers and Royalty Owners Association,** sixth annual meeting, Hotel Texas, Fort Worth.
March 29—**North Texas Oil and Gas Association,** Kemp Hotel, Wichita Falls, Texas.
March 31-April 2—**Western Petroleum Refiners Association,** annual meeting, Plaza Hotel, San Antonio, Texas.
April 2-4—**American Petroleum Institute,** division of production, Eastern district, Hotel William Penn, Pittsburgh, Pennsylvania.
April 8-10—**Southwestern Gas Measurement Short Course,** University of Oklahoma, north campus, Norman, Oklahoma.

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One of leading integrated manufacturers of wire rope seeks mature engineer familiar with rotary drilling equipment particularly, and possessing inherent desires and personality to sell. Initial location to be in Rocky Mountain area servicing oil fields; however, future opportunities are unlimited, dependent upon the man. Remuneration dependent upon experience, etc. If interested write this periodical, care Box 133, giving full details on education, experience, salary desired, etc. Your inquiry will be held in strict confidence. Our organization knows about this advertisement.

KOPPERS piston rings save time, labor and money

in all kinds of equipment

Railroads, trucks, buses, airplanes, cars, pumps . . . in every conceivable use of piston rings . . . Koppers provides *better* oil control, *more* power, *less* wear, *longer* life for expensive equipment!

Koppers K-Spun Piston Rings, produced by centrifugal casting process, are *100% stronger . . . four times more resistant to combustion shock than ordinary rings! They will not break in installation or for the life of the engine.*

Koppers Porous Chrome* Rings have a porous chrome surface that holds and distributes oil during break-in, quickly wears down to perfectly seated solid chrome that prevents grit and other particles from embedding in the ring surface where they can scratch cylinder walls. Porous Chrome Rings last up to four times as long as other rings, reduce cylinder wear 50% or more. That's why hundreds of companies are reporting amazing savings in equipment and maintenance costs through the use of Koppers Rings. Remember . . . we make rings for any equipment that uses piston rings.

*VAN DER HORST PROCESS

If you have a piston ring problem, why not get the *right* answer from us? Write, wire or phone Koppers Co., Inc., Piston Ring Dept., 1592 Hamburg St., Baltimore 3, Md.

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ONLY KOPPERS CAN FURNISH K-SPUN OR POROUS CHROME!

To obtain more information on products advertised see page E-41

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LONG, CONTINUOUS SERVICE LESS CARE AND ATTENTION

Reports of Case Oilfield Engines running non-stop for months on end make news now and then. Runs of such length may seldom be called for. But when they happen, they reflect the stamina and endurance that enable these sturdy engines to go a long time before overhaul, with a minimum of routine attention. Oil men also like the flat torque-curve of Case Engines, which enables them to carry normal load at reduced speed. It permits adjustment of pumping rate without change of pulleys or other parts. Four sizes, 24 to 61 H.P., offer good matching of engine to its task. J. I. Case Co., Racine, Wis.

CASE

April 14-17—**Petroleum Industry Electrical Association,** annual meeting, Mayo Hotel, Tulsa, Oklahoma.

April 16-18—**National Petroleum Association,** semi-annual meeting, Hotel Cleveland, Cleveland, Ohio.

April 21-23—**American Petroleum Institute,** division of transportation, pipe line meeting, The Blackstone Hotel, Fort Worth, Texas.

April 21-24—**American Petroleum Institute,** safety and fire protection committees, Hotel Texas, Fort Worth, Texas.

April 24-25—**American Petroleum Institute,** division of production, Rocky Mountain district, Gladstone Hotel, Casper, Wyoming.

April 28-29—**Independent Petroleum Association of America,** midyear meeting, Deshler-Wallick Hotel, Columbus, Ohio.

April 28-30—**American Oil Chemists Society,** spring meeting, Shamrock Hotel, Houston, Texas.

April 28-30—**Southern Gas Association,** annual convention, Galveston, Texas.

April 30-May 1, 2—**Natural Gasoline Association of America,** annual convention, Rice Hotel, Houston, Texas.

May 5-7—**American Geophysical Union, National Academy of Sciences** and **National Research Council,** Washington, D. C.

May 11-14—**American Institute of Chemical Engineers,** regional meeting, French Lick Springs Hotel, French Lick, Indiana.

May 12-13—**American Gas Association,** natural gas department spring meeting, Biltmore Hotel, Los Angeles, California.

May 12-15—**American Petroleum Institute,** refining division midyear meeting, St. Francis Hotel, San Francisco, California.

May 15-16—**American Petroleum Institute,** division of production, Pacific Coast, Biltmore Hotel, Los Angeles, California.

May 26-28—**American Gas Association,** production and chemical conference, Hotel New Yorker, New York City, N. Y.

May 29-31—**Seventh Annual Short Course in Gas Technology,** Texas A. and I. College, Kingsville, Texas.

June 8-12—**Canadian Gas Association,** Chateau Frontenac, Quebec City, Canada.

June 9-14—**American Petroleum Institute,** midyear standardization conference, Brown Plaza Hotel, Denver, Colorado.

June 23-27—**American Society for Testing Materials,** annual meeting, Hotels Statler and New York, New York City, New York.

July 1-Sept. 30—**Centennial of Engineering,** Museum of Science and Industry, Chicago.

NOMADS TO MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York. Secretary Fred J. Jobst. c/o Val A. Wittich, Jr., 30 Rockefeller Plaza, New York 20, New York.

Houston Chapter, Second Monday of the Month, Ye Olde College Inn, Houston, Texas. Secretary E. F. Baldwin, Hughes Tool Company, Box 2539, Houston, Texas. WO-3101.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Secretary W. A. Wilson.

Tulsa Chapter, Third Friday, "After Five" Room, Hotel Tulsa. Secretary R. E. Kirberger, Unit Rig Manufacturing Company, Tulsa, Oklahoma.

Dallas-Fort Worth Chapter, Dallas, Texas. First Monday of the Month. Secretary Gene Shiels, 205 Irwin-Keasler Building, Dallas, Texas. RI-4042.

To obtain more information on products advertised see page E-41

Over the hills and far away made easy

In the past several years Macco Corporation has constructed some of the major pipelines in Western America. Recently we completed the "Steep Inch" pipeline in Venezuela. However, our pipeline activities are by no means confined to big jobs. We have the equipment and crews to handle any size job, small or large, and are prepared to give around-the-clock emergency service in the Southwestern area. For large or small pipeline jobs on the West Coast—consult MACCO!

PIPELINE DIVISION

MACCO

DOES A JOB!

MACCO CORPORATION

14409 SOUTH PARAMOUNT BOULEVARD • PARAMOUNT, CALIFORNIA

BRANCH PLANTS: Colton • El Monte • Palm Village

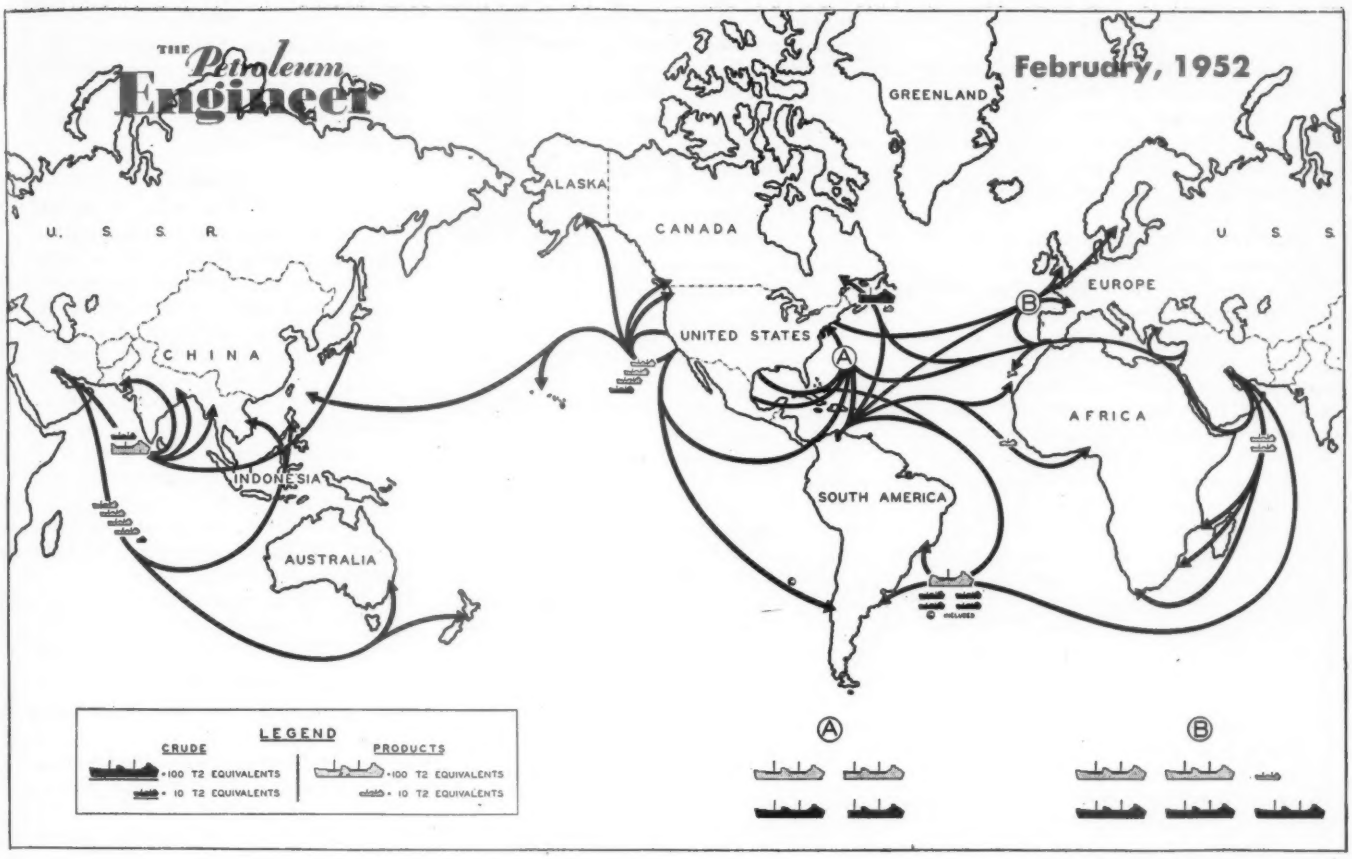
PL-3

VELOCITY[1] OF FLOW, FT. PER SEC., THROUGH 3-IN. TUBING

Rate of production, bbl. per day	Gas-oil ratio, cu. ft. per bbl.	Tubing pressure[2] at casinghead, lb. per sq. in. gauge								
		0	25	50	75	100	125	150	175	200
50	300	3.6	1.4	0.9	0.7	0.5	0.4	0.4	0.3	0.3
100		7.2	2.8	1.8	1.3	1.1	0.9	0.8	0.7	0.6
150		10.9	4.2	2.7	2.0	1.6	1.3	1.2	1.0	0.9
200		14.5	5.6	3.5	2.6	2.1	1.8	1.6	1.4	1.3
250		18.1	7.0	4.4	3.3	2.7	2.2	2.0	1.7	1.6
300		21.7	8.4	5.3	4.0	3.2	2.7	2.3	2.1	1.9
350		25.3	9.8	6.2	4.6	3.7	3.1	2.7	2.4	2.2
400		29.0	11.2	7.1	5.3	4.2	3.6	3.1	2.8	2.5
50	400	4.8	1.8	1.2	0.9	0.7	0.6	0.5	0.4	0.4
100		9.6	3.7	2.3	1.7	1.4	1.1	1.0	0.9	0.8
150		14.4	5.5	3.5	2.6	2.1	1.7	1.5	1.3	1.2
200		19.2	7.4	4.6	3.4	2.7	2.3	2.0	1.8	1.6
250		24.0	9.2	5.8	4.3	3.4	2.9	2.5	2.2	2.0
300		28.8	11.1	7.0	5.1	4.1	3.4	3.0	2.6	2.4
350		33.6	12.9	8.1	6.0	4.8	4.0	3.5	3.1	2.8
400		38.4	14.8	9.3	6.9	5.5	4.6	4.0	3.5	3.2
50	500	6.0	2.3	1.4	1.1	0.8	0.7	0.6	0.5	0.5
100		12.0	4.6	2.9	2.1	1.7	1.4	1.2	1.1	1.0
150		18.0	6.9	4.3	3.2	2.5	2.1	1.8	1.6	1.4
200		24.0	9.2	5.7	4.2	3.4	2.8	2.4	2.1	1.9
250		30.0	11.4	7.2	5.3	4.2	3.5	3.0	2.7	2.4
300		35.9	13.7	8.6	6.3	5.0	4.2	3.6	3.2	2.9
350		41.9	16.0	10.0	7.4	5.9	4.9	4.2	3.7	3.4
400		47.9	18.3	11.5	8.4	6.7	5.6	4.8	4.3	3.8
50	600	7.2	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.6
100		14.4	5.5	3.4	2.5	2.0	1.7	1.4	1.3	1.1
150		21.5	8.2	5.1	3.8	3.0	2.5	2.1	1.9	1.7
200		28.7	10.9	6.8	5.0	4.0	3.3	2.9	2.5	2.3
250		35.9	13.7	8.5	6.3	5.0	4.1	3.6	3.1	2.8
300		43.1	16.4	10.2	7.5	6.0	5.0	4.3	3.8	3.4
350		50.2	19.1	12.0	8.8	7.0	5.8	5.0	4.4	3.9
400		57.4	21.9	13.7	10.0	8.0	6.6	5.7	5.0	4.5
50	700	8.4	3.2	2.0	1.4	1.1	1.0	0.8	0.7	0.6
100		16.7	6.4	4.0	2.9	2.3	1.9	1.6	1.4	1.3
150		25.1	9.5	5.9	4.3	3.4	2.9	2.5	2.2	1.9
200		33.4	12.7	7.9	5.8	4.6	3.8	3.3	2.9	2.6
250		41.8	15.9	9.9	7.2	5.7	4.8	4.1	3.6	3.2
300		50.2	19.1	11.9	8.7	6.9	5.7	4.9	4.3	3.9
350		58.5	22.2	13.9	10.1	8.0	6.7	5.7	5.1	4.5
400		66.9	25.4	15.8	11.6	9.2	7.6	6.6	5.8	5.2
50	800	9.5	3.6	2.3	1.6	1.3	1.1	0.9	0.8	0.7
100		19.1	7.2	4.5	3.3	2.6	2.2	1.9	1.6	1.5
150		28.6	10.9	6.8	4.9	3.9	3.2	2.8	2.4	2.2
200		38.2	14.5	9.0	6.6	5.2	4.3	3.7	3.3	2.9
250		47.7	18.1	11.3	8.2	6.5	5.4	4.6	4.1	3.6
300		57.3	21.7	13.5	9.9	7.8	6.5	5.6	4.9	4.4
350		66.8	25.3	15.8	11.5	9.1	7.6	6.5	5.7	5.1
400		76.4	29.0	18.0	13.2	10.4	8.7	7.4	6.5	5.8
50	900	10.7	4.1	2.5	1.8	1.5	1.2	1.0	0.9	0.8
100		21.5	8.1	5.1	3.7	2.9	2.4	2.1	1.8	1.6
150		32.2	12.2	7.6	5.5	4.4	3.6	3.1	2.7	2.4
200		42.9	16.3	10.1	7.4	5.8	4.8	4.1	3.6	3.2
250		53.7	20.3	12.6	9.2	7.3	6.0	5.2	4.5	4.1
300		64.4	24.4	15.2	11.1	8.7	7.3	6.2	5.5	4.9
350		75.1	28.5	17.7	12.9	10.2	8.5	7.3	6.4	5.7
400		85.8	32.5	20.2	14.8	11.7	9.7	8.3	7.3	6.5

[1]Solution of gas and condensation under pressure are not considered; hence the values are maxima.
[2]Gas volumes entering into the velocity calculations are based on tubinghead pressure; atmospheric pressure is assumed to be 15 lb. per sq. in. in calculating the no. of atmospheres.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.



—Courtesy Sun Oil Company.

World petroleum tanker flow in 1950. The flow in 1951 would show much the same sweeping sea lanes but instead of products from Abadan, tankers carried crude oil from Kuwait and Iraq and Saudi Arabia. The mobility of tankers on oceans was the answer to a problem that hit the world petroleum industry suddenly despite warnings.

ROUND-UP OF WORLD OIL ACTIVITIES

Tankers saved the day in 1951 when an oil-hungry world was suddenly deprived of Iran's 700,000 bbl a day production

ERNESTINE ADAMS*

1951 was the year of the tanker.

This was the year when the great oil tankers that ply the seven seas played a major role in the world oil industry. Of course, they have always been there, carrying crude oil and oil products from one country to another—from one continent to a far-off one—from one hemisphere to the other. As world production reached 500,000 bbl a day in 1915, when it went to one million a day in 1927, and finally hit 12 million a day in 1951, the tankers followed the oil industry. They grew bigger and more numerous as production grew. They gained speed and size and took on improvements that made loading and unloading time shorter. They supplied two world wars and were unsung heroes.

But it took one of those political crises that seem to have multiplied in recent years for the tanker to get better than a walk on (or sail-on) part in world oil affairs.

This was known as the Iran crisis. What happened occupied news headlines for almost a year but the plot is more Gilbert and Sullivan than Wagner.

First, a member of the fanatical Fayadan Islam group assassinated a moderate premier of Iran, Razmara, and a frail, fainting, but infinitely tough Mossadegh become premier.

In March the Iranian Parliament voted unanimously to nationalize the oil industry, to take over the Anglo-Iranian Oil Company's concession. Then followed the shilly shallying of the western democracies. The Socialist British government talked about protecting her contract and her nationals. She went to the World Court and got an injunction of sorts but couldn't find a world sheriff to enforce it. The U. S. State Department tried George McGhee, W. Averell

*Managing Editor.

EXCLUSIVE

Harriman, and Loy Henderson to no avail.

Mohammed Mossadegh seized the opportunity of visiting the U. S., coming in on a stretcher at New York and evidently getting livelier by the minute until he left Washington, D. C., with expressions of satisfaction but no oil agreement.

Production in the one-time British concession dropped from 700,000 bbl a day to practically zero. The largest refinery in the world, at Abadan, slowed to a stop. After some blustering the British got out. The Iranians could not run the fields and plants efficiently without aid, and they had no customers with tankers who could come and get the oil if it could be produced and refined.

The Anglo-Iranian Oil Company advertised a threatened suit against any one who bought the oil in violation of the 1933 contract, which was to run to 1993. The Iranian government advertised it could, too, sell the oil.

Iran held onto the billion-dollar possessions but was going as bankrupt in a small way as the British government was in its own larger way. Both wanted bailing out by the U. S. A.

Mossadegh was trying to sell oil to Poland and Russia and Czechs, while Britain was actually buying oil from another Iron Curtain country, Romania. But Britain had the tankers and the tankers were what counted.

Results of this drama of a thousand acts were not catastrophic as might be expected. Nobody was pinched for oil.

The oil industry began the year with high production because of the Korean war and accelerated military preparations. It produced in January, 1951 an average of 11,254,000 bbl a day. At the end of the year, despite the loss of Iran oil production, daily output was pushing 12,000,000 bbl a day and reserves were at a record high. This meant that oil production outside Iran had risen more than 1,000,000 bbl a day.

Before Iran closed down the world was wondering what could be done to overcome the prospective oil shortages. Already competitors are worrying about the glut on the market when and if Iran ever gets her oil industry operating again.

Who had accomplished this terrific task? All the world's oil operators from the one-rig contractor in the Mid-Continent to the big Anglo-Iranian Oil Company, with its best property nationalized and out of the running. The United States led the increase, the Middle East came next, and the rest of the world followed.

The tankers did the rest. Instead of oil products from Abadan, they filled up at the new pipe line from Iraq to the Persian Gulf. Kuwait's big terminal filled 45 tankers a week. Then the ships took off for the huge new refineries that ECA funds had helped to build in Europe and the United Kingdom.

There was the fear on the part of Western Democracies that Russia would get Iranian oil but how could she when she had no tankers to speak of and the western nations' tankers, more than a thousand, plied oceans and seas and gulfs and rivers, carrying oil to anyone who wanted to buy and was not warring with their owners.

Geologists and geophysists lit out for parts unknown. Who ever heard of Uganda? Almost nobody, but geologists knew it had a sedimentary basin so the astonished natives are probably hearing the dynamite shots of seismograph crews.

In a way Iran's loss is the gain of many parts of the world, which will get an oil industry's "Point Four" that will be more practical than any political "Point Four" that can be arranged.

The big weakness of Anglo-Iranian is not that it is a big oil company gouging profits from a backward nation. In fact, there is ample evidence that the company did more for Iran than the country could ever have done for itself. Benefits are not always royalties and the schools and hospitals and training and jobs that Anglo-Iranian contributed are probably more than the people would have got had the money, instead, been paid to the government.

The weakness is that the British government is majority stockholder in Anglo-Iranian. The government should be able to stand outside the dispute between the Iranian government and the privately owned company. It might even have been the arbitrator between the two. Instead the Iranian government saw the big profits going to the British government and top of that, *huge tax payments.*

The Iranian crisis may prove not only a gain to oil development in other lands, it may also prove to be a guide on government-business partnership on "Point Four."

A government participating in business does not have the diplomatic prestige of a government whose prime interest is in the welfare of its citizens and their enterprises abroad.

Whatever the causes of the disturbance, that brought a failure of diplomacy and ended in the crucial cutting off of oil supplies in a world of growing demand, the tankers supplied the catalyst. The tankers went wherever they could fill up and take off for oil-hungry nations. Nobody suffered.

Time Magazine named Mossadegh Man of the Year. It should have named the many faceted oil industry instead—the oil industry that submerged the Iranian firecracker in a flow of new exploration, greater production, towers of refining, great tubes of pipe, and those stoic miracles of world distribution, the tankers.

Following are activities in individual countries during the year 1950. We are indebted to petroleum departments of various nations, companies operating in foreign countries, and Bureau of Mines statistics for information used here.

Production given in each case is not 1951 average but production at close of year. Refining capacity is latest available figure.

ADEN

Anglo-Iranian Oil Company is reported considering the construction of a refining plant in either the colony or protectorate. Aden is on the south tip of Arabia.

ALASKA

A committee of advisers to the Secretary of the Navy on oil exploration in Naval Petroleum Reserve No. 4 released a statement in November confirming an oil field at Umiat on the Colville River and widespread existence of gas in the NPR. Estimates of the Umiat field range from 30 to 100 million barrels.

The 1951 drilling schedule called for 19 wells, 4 less than 1000 ft deep. Exploration will be continued on a year-to-year basis with geologic and seismic investigations in 1953 including 5 test wells to 4000 ft, according to Captain Robert H. Meade, director of the Naval Petroleum Reserves.

Union Oil Company of California and Ohio Oil Company had two field parties in Alaska conducting geological studies.

ALBANIA

Prod. 5000 b/d **Ref. Cap. 750 b/d**

These figures are more guess than estimate as information is extremely meager. How and to whom the extra crude is exported is not known. Yugoslavia once took the surplus but relations are less than friendly between the two countries now.

ALGERIA

Prod. 140 b/d

Five geophysical teams were at work in Algeria, according to S. N. REPAL, the government company, at the end of 1951 and the five rigs in use during the year drilled 97,000 ft. Two light rigs drilled in the Oued Gueterini field; larger ones explored basins of Chelif and Hodna. Prospects seem encouraging for greater production and some experimenting with proper methods are being conducted.

ANGOLA

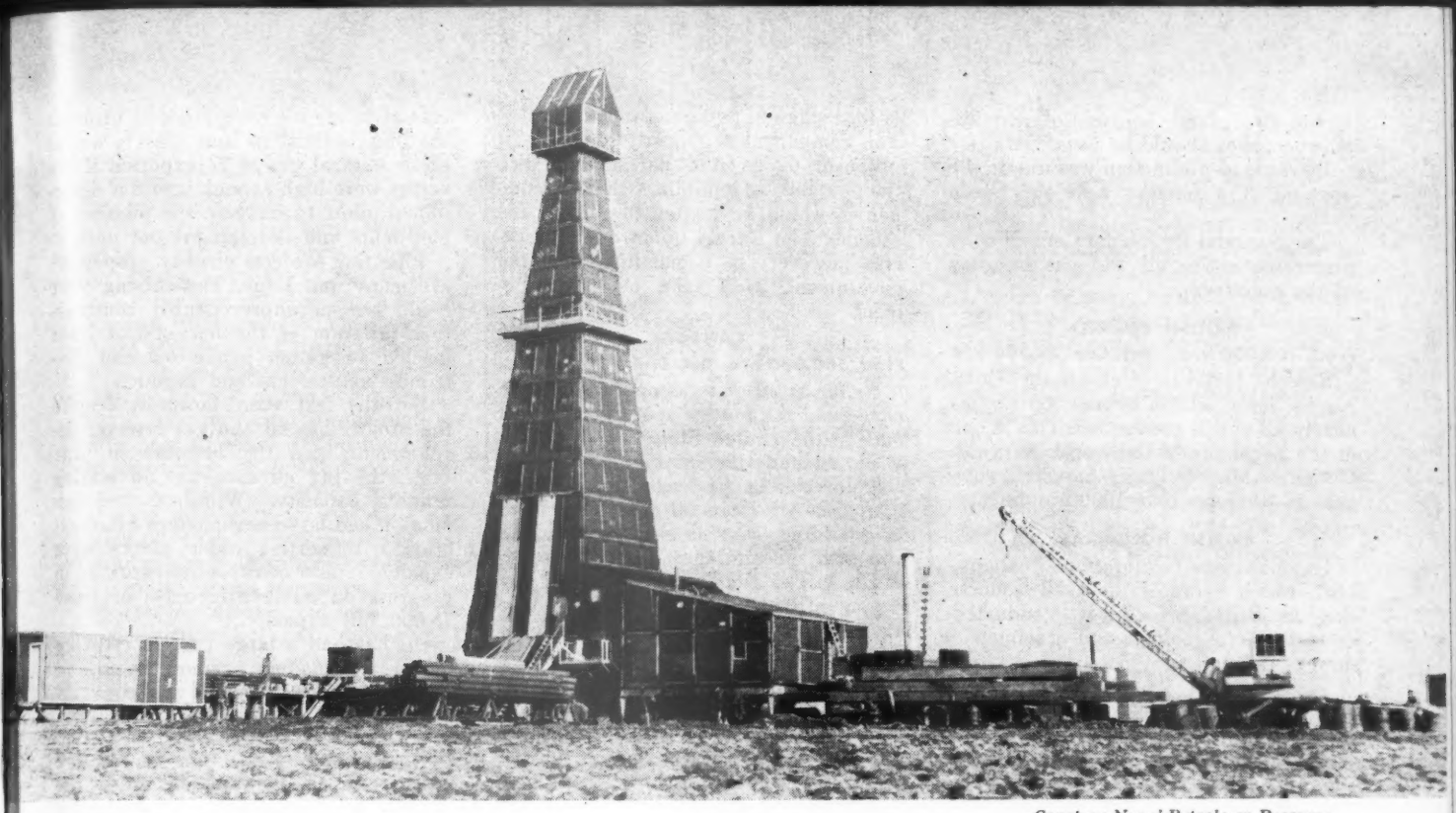
This Portuguese territory on the west coast of Africa continues to attract attention. Geological work has been done by Companhia dos Betuminosos de Angola and by Jersey Standard along the coast. The former company has also done some test drilling.

ARGENTINA

Prod. 68,000 b/d **Ref. Cap. 170,000 b/d**

Oil and gas production have both increased in this country but the industry is in an unhealthy state. Private companies (Jersey Standard and Shell principally) cannot enlarge their holdings and can only develop present concessions which were granted in 1925. Yacimientos Petroliferos Fiscales, government monoply, produces about 60 per cent of the crude oil and refines more than half of the total output.

The YPF discovered in 1950 that Chile's Spring Hill field extends across the national boundary into Argentina on the Tierra del Fuego, but drilling in this area has not been extensive. Pro-



—Courtesy Naval Petroleum Reserves.

Rig at Titalik, Alaska, on Naval Petroleum Reserve No. 4.

duction is from the Springhill sand at about 6700 ft.

Refining capacity has increased far more than production and imports to bring throughput up to capacity have not been available, despite the fact that private companies are pushing crude production as high as possible.

AUSTRALIA

Ref. Cap. 21,200 b/d

The almost 20,000 bbl a day capacity of Australia was increased by about 1500 bbl a day at the Standard-Vacuum plant at Altona where a Platformer was installed. This is the first plant expansion of any size in three years. Shell is making additions to its plant facilities and Anglo-Iranian is planning a new refinery in Australia, which will be the largest in the country.

Another blow to the nation's hope for oil production was the abandonment of Shell's Morella test in Queensland in 1950. It was drilled to 4634 ft into the basement. Shell relinquished its concession. A new local company has been organized to carry on drilling operations near Roma.

After spending more than $10 million the Commonwealth government has decided to sell its shale mine and oil refinery at Glen Davis.

AUSTRIA

Prod. 40,000 b/d Ref. Cap. 29,000 b/d

The Russian-controlled oil fields are being pushed to higher production and large sums are said to have been allocated for increased development. Two fields discovered by the Soviet Mineral Oil Administration, Matzen and Aderklas, account for about 11,000 bbl a day. Discovery of another rich new field near Buckfliess has been reported from behind the closely guarded Russian sector. All petroleum information is considered top secret by the USSR.

Austrian engineers are said to be sent to Moscow for training in Soviet exploitation methods and there seems to be extraordinary concentration of development in known fields.

The refineries are reported to be inefficient by modern standards, only two of the seven having cracking facilities.

BAHAMAS

The only operating companies that renewed their exploration licenses in 1951 for a further term of one year were: Bahamas Oil Company (Superior) Nassau Oil Mining Company, Ltd., and Bahamas Exploration Company (Gulf).

Little or no field work was done in 1951 by these companies, according to the Colonial Secretary's office.

BAHREIN ISLAND

Prod. 31,000 b/d Ref. Cap. 155,000 b/d

BARBADOS

A gravity survey covering all of the land area of Barbados, West Indies, was completed early in the year. To check the gravity anomalies and provide a definite location for the first deep test scheduled for 1952 a contract seismic survey was undertaken at mid-year.

BELGIUM

Ref. Cap. 46,500 b/d

Highlight of Belgium's year was completion of the Anglo-Iranian and "Petrofina" 30,000 bbl capacity refinery at Antwerp, the largest in the nation. Refinery runs have been high throughout Europe, especially since the closing of the Abadan refinery in Iran.

BOLIVIA

Prod. 1600 b/d Ref. Cap. 10,860 b/d

The 1950 revision of the petroleum law to allow mixed government and private interest companies has failed to attract private capital to Bolivia so far. The difficulties of exploration and export of production might be offset by promise of high profit, to bring in private foreign capital.

Completion of the 5000-bbl capacity Cocha Bamba refinery by the YPFB, government oil monoply, has raised the refining capacity of the country to a figure higher than consumption. Refinery runs at present seems to be domestic production only.

YPFB has plans for some exploration and development drilling in 1952, the extent depending upon amount of modern rotary drilling equipment available.

BORNEO

Prod. 15,000 b/d Ref. Cap. 27,000 b/d

Important work during the year in this East Indies region was the expansion project at the Balik Papan refinery. When the construction work is completed the plant will have crude capacity of 44,000 bbl a day. Distillation units are expected to be completed about mid-year but the entire project will not be ready before 1955.

Exploration was continued by Shell.

BRAZIL

Prod. 1400 b/d Ref. Cap. 4700 b/d

The Brazilian petroleum industry suffers from politics. Refinery expansion projects are in all stages of planning and construction and by 1954 the nation is scheduled to have some 175,000 bbl refining capacity. Construction was held

up on two plants because of disputes on where they should be situated.

Increase in production was due to the opening of a refinery near the Bahia fields.

The National Petroleum Council comprises the entire oil and gas industry of the country.

BRITISH BORNEO

Prod. 100,000 b/d Ref. Cap. 38,500 b/d

British Malayan Petroleum Company's Seria field in Brunei contributes nearly all of this production. This is one of the big fields of the world. Sarawak Oilfields' Miri field in Sarawak runs only a little more than 1000 bbl daily.

BRITISH HONDURAS

The Bahamas Exploration Company, Ltd., which operates the Gulf concession in British Honduras, conducted extensive field geologic and gravimetric surveys throughout 1951.

BURMA

Prod. 2000 b/d Ref. Cap. 1500 b/d

It is difficult to estimate activity in this land where bandits and patriots and rebels struggle for power. Only troops guarding fields allow the present production.

Burma Oil Company, which with the British government also controls the Anglo-Iranian Oil Company, has the largest stake in regaining some stability. The company has recently renewed its proposal to go into partnership with the new Burma republic. Other oil companies would be invited to join in the scheme. The Burma union of oil workers, however, is demanding that the government itself take over management.

CANADA

Prod. 160,000 b/d Ref. Cap. 410,000 b/d

So far as oil and gas operations were concerned the hottest spot in the world outside the United States was Canada. Given virtually the same freedom of development as in the United States, more than 200 American oil companies have invested huge sums in exploration alone and with substantial success.

The last of 1951 saw the first oil discovery in British Columbia and the New Year ushered in the first discovery of medium or light oil in Saskatchewan. A major new field is the Wizard Lake oil field in Alberta.

Oil reserves stood conservatively at 3 billion barrels and gas at some 5 trillion cubic feet after a record discovery year of 110 oil and gas fields.

Production of oil and gas in the western areas is dependent upon the coming of the pipe lines to a large extent. In the first full year of operation of the Interprovincial some 46 million barrels of crude oil were pumped through the line. Indications that Alberta would allow natural gas to be exported if reserves were high enough meant a determined effort to increase the number of gas fields and develop present ones.

Pipe line projects already proposed* are many and large. The coming year could see an unprecedented construction program of the network of lines needed to gather crude oil and distribute natural gas and products.

For the last year, however, despite the progress in oil and gas reserves development, and the increase in pipe lines, the big advance was in adding refining capacity.† Winnipeg and Edmonton had large new modern Fluid cat cracker refineries; older plants were expanded; and construction work is in progress on another increase of some 75,000 bbl capacity.

Oil has had a large part in creating the great Canadian business boom and its solid national financial shape.

CHILE

Prod. 2000 b/d Ref. Cap. 300 b/d

Most of the production from the world's most southern oil producing area is going to Uruguay by tanker. The government-owned oil monopoly, Corporacion de Fomento, plans a 16,000 bbl a day refinery.

Exploration and development of petroleum resources is now under another state-owned company, Empresa Nacional del Petroleo. It is actively developing the Tierra del Fuego fields and wildcatting in the region.

CHINA

(Communist)

Prod. 2000 b/d Ref. Cap. 4500 b/d

The Bureau of Mines estimated the production of Communist China for 1951 at a little above 2000 bbl a day. The petroleum industry is under a Russian-Chinese management like those of most satellites. Reports mention exploration in Sinkiang, north of Tibet, which is considered promising by geologists. Production is mostly from Kansu where the refining plants are.

COLOMBIA

Prod. 105,000 bbl Ref. Cap. 32,000 b/d

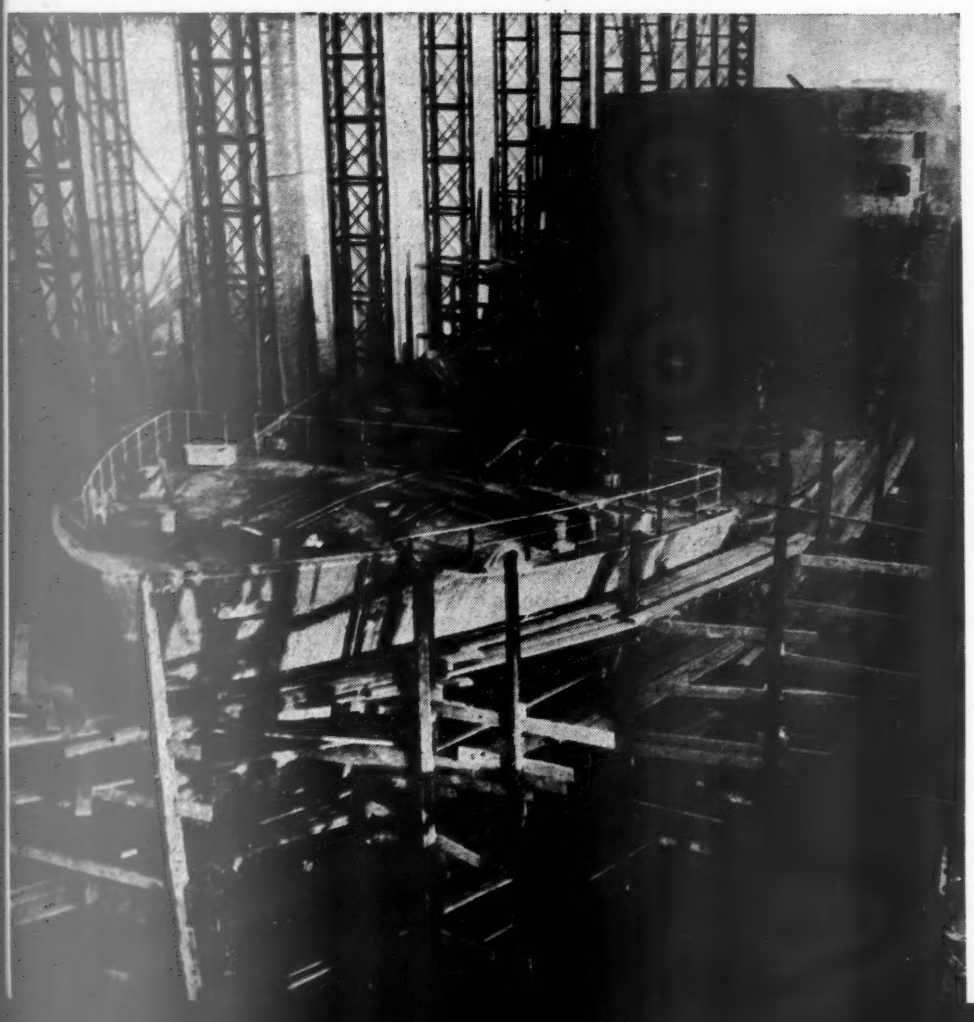
Colombia has revised its laws restricting foreign oil companies in their operations and has given some tax relief so that 1951 saw the promising results of the more liberal policy.

Tropical Oil Company (Jersey Standard) returned its 30-year-old concession of more than a million acres to the government with 1030 producing wells and a reserve of some 108 million barrels and a 25,000 bbl capacity refinery. A plan has been worked out whereby the government-operated National Petroleum Company would operate the concession with the technical advice of International Petroleum Company (Jersey Standard) and International will

*"Many Pipe Lines Proposed for Canada," Harry Chapin Plummer, The Petroleum Engineer, Nov. 1951, Page D-28.

†"Canada's Oil Year," Leslie Orr Rowland, The Petroleum Engineer, January 1952, Page A-46.

The M/S Caltex-Delhi, below, has been launched at Sunderland, England. It is one of nine tankers of Overseas Tankship (U.K.) Ltd. being built in England and is the third one to be launched. The massive building program going on can be estimated by the fact that in 1950 the Shell interests gave orders to ship builders in the Netherlands and United Kingdom for 41 tankers of 18,000 dw tons and five tankers of 28,000 dw tons at a cost of about 1¼ billion dollars.



finance the expansion of the refinery and the building of an 85-mile oil pipe line to connect Bogota with the De Mares Concession.

Several U. S. companies have been exploring new sections opened now for leasing. Texas Petroleum Company (The Texas Company), Shell, Richmond (Standard of California), and Colombian Petroleum (Socony-Vacuum) are all developing their concessions and taking advantage of new pipe line outlets to increase production.

Shell has increased production at Casabe field to about 37,000 bbl a day from an average of 26,500 during 1950.

Texas Petroleum completed three new producing wells at Velasquez field, discovered in 1946, and a pipe line was built from the field to La Dorada. Two new wells were completed in the Chaparral-Ortega area but no outlet for this production has been constructed. International found a new field at Totumal on a 120,000-acre concession taken this year.

The year 1951 was overall a good one for Colombia, second largest producing nation in South America.

COSTA RICA

Union Oil Company of California and the government of Costa Rica have signed a contract giving Union Oil the exclusive rights to search for oil and gas in the provinces of Limon and Guanacaste, comprising nearly 5,000,000 acres.

CUBA

Prod. 350 b/d **Ref. Cap. 7,300 b/d**

The Atlantic Refining Company, through subsidiaries and partners, continued to maintain concessions in Cuba on an inactive basis.

Gulf's second deep test was drilling at a depth of 10,000 ft at year-end. In addition to the deep test drilling a structure drill project was underway at the end of 1951 and was expected to continue into 1952.

CZECHOSLOVAKIA

Prod. 1000 b/d(?) Ref. Cap. 2500 b/d(?)

The Zisterdorf petrolific area in Austria extends into Czechoslovakia and fields in both countries are part of an intensive development plan.

DENMARK

Ref. Cap. 750 b/d

The Danish American Prospecting Co. (Gulf) abandoned its Gassum No. 1 deep test at 11,359 ft with a fish in the hole. At end of year the Tonder By No. 1 deep test in South Jutland was drilling at 8107 ft. Four stratigraphic tests were completed during 1951, namely, Ringe No. 1 to 4726 ft. Ullerslev No. 1 to 3488 ft, Glamsbjerg No. 1 to 2992 ft, and Uglev No. 1 to 4080 ft. Seismic activities were continued on an expanded scale, two parties being in action at the end of the year. No oil occurrences were encountered during 1951.

ECUADOR

Prod. 7900 b/d **Ref. Cap. 5700 b/d**

Manabi Exploration Company, an organization of U. S. oil men who took over the interests of Ecuador Oilfields, Ltd., a British concern, has been successful in developing greater production in its concessions and is carrying on exploration and a shallow wildcat drilling program. The company plans to complete a $250,000 natural gasoline plant and a topping unit this year.

Anglo-Ecuadorian Oilfields, Ltd., has the largest refinery, which is at La Liberdad, and the largest producing field at Ancon.

EGYPT

Prod. 47,000 b/d **Ref. Cap. 47,000 b/d**

Glen McCarthy, independent oil operator, came from Egypt last fall with optimistic reports on results of negotiations to obtain a large concession from Egypt without the limiting ownership clause now in the petroleum law. At the present time concession can be granted only to Egyptian companies, or those whose capital is owned 51 per cent by Egyptians.

A government under this law took over the Standard Jersey concession, which included the new discovery at Wadi Feiran, south of Suez. Socony-Vacuum and Shell are operating their concessions granted prior to 1948 petroleum laws.

Two refineries in the Suez are those of Shell and the government company. The latter is still expanding its plant and part of the new capacity is in use. As usual Egypt processes all her own production but no more.

ETHIOPIA

Sinclair Petroleum Company, principal operating subsidiary of the Sinclair Oil Corporation, has selected a drilling site for its second well in Ethiopia.

The new site is near the village of Galadi in the Ogaden Province, approximately 45 miles east of the original well. Selection of this location was made after slightly more than two years of intensive field operation, which included seismographic, gravity meter and magnetometer surveys, as well as some shallow hole structure drilling. At the present time, the company is recruiting a drilling crew in the United States and it is anticipated that actual drilling operations will commence early in 1952.

FORMOSA

Prod. 70 b/d **Ref. Cap. 18,000 b/d**

Crude oil production is evidently unchanged. Actual refinery runs are far below capacity, the Bureau of Mines estimating the throughput at about 4500 bbl a day.

FRANCE

Prod. 5700 b/d **Ref. Cap. 392,000 b/d**

Geological and geophysical studies are continuing in France. This determined effort to find oil if it is there goes on despite a high proportion of dry holes in the drilling program. Production is small but it shows great improvement. Before the war France produced about 1400 bbl a day and this dropped to about 1000 bbl in 1947. The first upturn was last year when production reached 2400 bbl a day and now it has more than doubled for the second year. This comes principally from the Lacq field, found in 1950, and Pechelbronn field.

Refining capacity is also climbing. The new Dunkirk refinery, rebuilt from the war damaged plant, will reach 37,800 bbl a day capacity by April, 1952. L'Avera refinery, South France, with a 34,500 bbl a day capacity, has tripled its pre-war rating, and is running full capacity. Capacity of the Berre refinery was expanded from 25,000 to 63,000 bbl daily.

FRENCH EQUATORIAL AFRICA

Exploration and drilling activity in the Gabon basin on the west coast. Societe des Petroles d'Afrique Equatoriale Francaise has the concession and has been keeping two rigs drilling.

WEST GERMANY

Prod. 27,000 b/d **Ref. Cap. 111,000 b/d**

There have been intensive exploration and drilling programs carried on this year by a dozen or more companies until West Germany now has 37 fields and produces more oil than any other European country. The amount, however, is only about one-third consumption.

One interesting new find is a gas field near Frankfurt, far from any known oil or gas field. Development continued at the Suderbruch field where a second producing zone was found last year.

Refining capacity has been expanded and construction work is still going on. Most of these are in the Brtish zone of occupation.

German shipyards at Hamburg this year got orders for two 40,000 dw ton tankers, claimed to be the largest in the world. They will be completed in 1953 and 1954, respectively. The growing need of tankers has added another flourish to the German economic expansion.

HAWAIIAN ISLANDS

Ref. Cap. 3000 b/d

Pacific Refiners, Ltd., completed its plant at Honolulu in 1951. It will make asphalt.

HUNGARY

Prod. 9000 b/d **Ref. Cap. 23,000 b/d**

These figures are guesses based on fragments of news and rumors that slip between iron curtain rivets. Hungary is reported not to have met its quota, the term in vogue by state planners. The amount of the quota is not stated but the goal is generally higher than the actual rate so there is no reason to believe there was much change. If anything the estimate is probably on the high side.

INDIA

Prod. 5500 b/d **Ref. Cap. 5500 b/d**

Assam Oil Company (an affiliate of Anglo-Iranian) is increasing geophysical work and exploratory drilling despite small success so far.

Burma-Shell are considering the construction of a refinery at Bombay at the request of the Government of India.

Standard Jersey was offered a liberalized agreement to guarantee ownership for an extended period if it would build a refinery in India. American Koppers Company has proposed two synthetic gasoline plants.

India received most of her refined products from Abadan and the closedown of the Iranian plant made her realize the importance of home refineries.

IRAN

Prod. 80,000 b/d Ref. Cap. 572,000 b/d

When the oil industry was nationalized and British employees of Anglo-Iranian Oil Company were forced out of Iran, the production slowed to a mere trickle from about 700,000 bbl a day, which AIOC had been producing. Recent Iranian sources say that 80,000 bbl is being produced for domestic use.

The Abadan refinery, with some 500,000 bbl a day capacity, has been shut down and supposedly the two other processing plants are also quiet.

See introduction for further news of Iran.

IRAQ

Prod. 170,000 b/d Ref. Cap. 8500 b/d

Iraq is profiting by Iran's oil crisis. Large new pipe lines have been completed to carry more oil to Tripoli, new oil fields, shut in because of transportation, were opened up. A new refinery was scheduled for 1952 to be built south of Basra, near Zubair oil field, a deep field where development is being intensified to replace lost Iranian production. The field is reported to have a production rate of 40,000 bbl a day.

Production of all fields is limited by pipe line facilities. A 16-in. line has been completed beside the original 12-in. line from Kirkuk to Tripoli. The political tension between Isreali and the Arab nations has closed down the pipe line to the refinery at Haifa. But a new 30-in. line with a capacity of 250,000 bbl a day is now being laid from Kirkuk to Banias in Syria on the Mediterranean. Another line was built from Zubair field to Fao on the Persian Gulf for tanker shipment.

Iraq won its greatest victory in the new royalty agreements with Iraq Petroleum Company (owned by British, U.S., Dutch and French interests), and associated companies Basrah and Mozul. Under the new agreement Iraq obtains a 50 per cent share of the profits. Royalties probably reached $42,000,000 in 1951 and they are expected to rise to $156,000,000 in 1955.

The Iraq government also took over control of the Khanaquin oil fields and distribution of oil products from the refinery near there for local consumption.

ITALY

Prod. 250 b/d Ref. Cap. 180,000 b/d

Oil development and production of Italy's small fields are in the hands of a government-owned company, Azienda Generale Italiana Petroli. Gas fields are more promising so far and a AGIP pipe line system supplies towns in the Po Valley and is expanding.

The expansion of refining capacity in Italy is tremendous. It is over half way toward the goal of 300,000 bbl a day capacity by the middle of 1953, which was stated in the plans submitted by the Italian government to ECA.

Shell's La Spezia refinery is being expanded to a capacity of 30,000 bbl.

ISRAEL

Ref. Cap. 80,000 b/d

The Arab League persisted in its refusal to allow passage for crude oil supplies in the Haifa refinery, either through the Iraq pipe line, from Kirkuk, or through the Suez Canal from the Persian Gulf—in spite of a U. N. condemnation of the Egyptian blockade. Crude oil is being brought by tanker, partly from Venezuela and partly from the Persian Gulf—in the latter case by making the trip around the Cape of Good Hope. This state of affairs makes the operation of the Haifa refinery for exports uneconomical, and only refining to meet local consumption is carried on (about 7,000,000 bbl per annum — or 25 per cent of the refinery's capacity†). However, due to the country's fast increasing population (it has more than doubled within three years) and expanding economy, local consumption of products is steadily increasing, at a rate of some 1,500,000 bbl a year, according to I. R. Kosloff, petroleum adviser to the Israel Ministry of Finance.

At talks held between the Government of Israel and the refinery's management (the Anglo-Iranian Oil Company) accord has been reached on most of the main issues of a new agreement to replace the one previously granted by the British mandatory government. The new agreement, when ratified, will provide, inter alia, for the supply of tail gases from the refinery for the development of local petro-chemical industry, and for refining options, which will form the base for a newly established national marketing company, whose target is to handle 30 per cent of the local consumption. A lubricating oils refining plant, having a reclaiming capacity of 25,000 bbl a day, has been put on stream in Lydda by Pressure Lubricants, Ltd.

Following Max W. Ball's favorable report on Israel's oil prospects, the government is preparing a new petroleum exploration law, which will soon be submitted to the legislature. This legislation has been drafted with a view to attract potential investors while safeguarding national interests.

†Other sources report runs at less than 2000 bbl a day.

Booklet Describes Economics of Oil Industry in 1951

"Some Economic Aspects of the Oil Industry in 1951" has been published by the Manchester Oil Refinery Limited and Petrocarbon Limited. Written by Georg Tugendhat, managing director, and Catherine Mackintosh, head of market research, the booklet is issued as a special supplement to the company magazine, "Oil." The first three tables in the accompanying article are taken from this source.

JAPAN*

Prod. 6390 b/d Ref. Cap. 70,000 b/d

Excessive production from the recently discovered deep reservoirs in Yabase field, Honshu, which contain more than 50 per cent of Japan's proved reserves of crude, accounts for the 14 per cent increase above 1950 production. Gross mismanagement involving flagrant disregard of proper production practice and conservation principles at Yabase boosted daily production from 5800 bbl in January to 7570 bbl in June before production control was enforced after a joint investigation by Occupation and Japanese Government authorities. The value of crude lost to primary recovery because of wastage of reservoir energy at Yabase is estimated to be about $2,000,000. These malpractices began after Imperial Oil Company (Teikoku Sekiyu K.K.) changed its status in mid-1950 from that of a semi-government corporation to a private enterprise, and after Occupation controls began to be relaxed. This company now produces more than 95 per cent of Japan's crude oil. Unless Japan becomes economically independent in the future it is probable that the United States taxpayer will have to replace with additional foreign aid funds the crude reserves lost through the greed of a few irresponsible individuals who still retain control of the company, despite protests to the Japanese Government by Occupation authorities. The continued shelving of the proposed Law for National Development of Petroleum Resources, which contains conservation measures recommended long ago by competent American petroleum engineers provided by the U. S. Government for that purpose, indicates that there now seems little hope that such malpractices, for which the U. S. taxpayer or the Japanese people themselves must eventually pay, will be corrected.

No major oil discovery was proved during the year, although the finding of oil in small quantities by wildcats drilled in two different structures in a deeper horizon than any formerly known to be productive in Niigata prefecture has opened up a new field for further investigation. The highlight of the year was the discovery of natural methane gas in commercial quantities at depths of 1600 to 2200 ft in the northern part of Tokyo City; this dry gas, like that of the methane gas fields around Niigata City and in Chiba prefectures, is produced with saline artesian water. Because of financial difficulties, development is proceeding slowly at present, but the new discovery promises to develop into a major enterprise in the future.

Total refining capacity is now some-

*Leo. W. Stach, Technical Consultant, Petroleum and Natural Gas, Tokyo Central Post Office, Box 124, Tokyo, Japan.

World production of crude oil—percentage distribution.
(From "Some Economic Aspects of the Oil Industry in 1951," published by Manchester Oil Refinery, Ltd., and Petrocarbon, Ltd., London.)

Year	World Actual production 000 bbl	Approx. million tons	per cent	U.S.A. per cent	Other N. American per cent	South America per cent	Middle East per cent	Europe incl. U.S.S.R. per cent	Other per cent
1860	509	0.071	100	98.4	—	—	—	1.6	—
1870	5,799	0.8	100	90.7	4.3	—	—	5.0	—
1880	30,018	4.1	100	87.6	0.1	—	—	11.2	1.1
1890	76,633	10.5	100	59.8	1.0	—	—	38.9	0.3
1900	149,137	20.4	100	42.7	0.6	0.2	—	53.7	2.8
1918	503,515	69.0	100	70.7	13.2	0.8	1.7	8.5	5.1
1928	1,324,774	181.5	100	68.0	4.5	11.2	3.3	9.2	3.8
1938	1,988,041	272.3	100	61.1	3.3	12.3	6.0	13.2	4.1
1949	3,399,290	465.7	100	54.2	3.0	16.3	15.0	8.6	2.9
1950	3,783,284	518.3	100	52.1	2.7	16.9	16.8	8.5	3.0
1st half 1951	2,128,981	286.0	100	51.6	2.8	16.7	18.2	9.0	1.7

what in excess of 70,000 bbl daily. Increased domestic production maintained the Japan Sea coast plants, processing domestic crude only, at about 75 per cent of capacity. Since the reopening early in 1950 of the refineries processing imported crude on the Pacific Coast, rehabilitation proceeded rapidly and raised the capacity to the present level of 61,000 bbl daily. Affiliation of foreign oil companies with the existing Japanese companies provided new capital for expansion of installations and assured sources of crude for Japanese refineries. Imports of crude reached the level of 58,000 bbl daily in the last quarter of 1951, 73 per cent of which was derived from dollar areas and the remainder from sterling areas. Refinery runs averaged about 45,000 bbl daily during 1951.

With future consumption of petroleum products estimated at 36,000,000 bbl annually, refining capacity on the Pacific Coast is expected to be increased to 80,000 bbl daily. Mitsubishi Oil Company (associated with Tidewater and Shell) is expanding its Kawasaki refinery about 60 per cent to a capacity of 11,000 bbl; Showa Oil Company's Kawasaki refinery (associated with Shell) is being increased from 6000 to 10,000 bbl daily; Toa Nenryo Kogyo Company (associated with Standard-Vacuum) is planning an increase from 5000 to 10,000 bbl daily at its Shimizu plant and installation of a catalytic cracker with 500 bbl daily capacity; Nippon Oil Refinery Company, recently established by the Nippon Oil Company on a 50-50 basis with Caltex, is now expanding the capacity of its Yokohama refinery from 5350 to 12,000 bbl daily; Maruzen Oil Company, which has supply contracts with Union and Shell, recently began processing 2000 bbl daily at its Matsuyama refinery.

JAVA

Prod. 13,000 b/d Ref. Cap. 2000 b/d

Kawengan in the Rembang fields has been rehabilitated and is producing more than 11,000 bbl a day. Kruka in the Surabaja region continues to produce more than 1000 bbl a day. The other fields in Java are still shut in, not having been reactivated since the last world war.

Shell is carrying on exploration work in the eastern part.

KUWAIT

Prod. 800,000 b/d Ref. Cap. 26,500 b/d

Kuwait is another country benefited by the shut down in Iran. Owned by Gulf and Anglo-Iranian, the small concession has the most fabulous oil field in the world, the Burgan field, which has 15 billion known reserves. Daily production at the end of the year reached the target figure of 800,000 bbl a day.

An exploratory well, drilled some eight miles north of the northernmost well in the Burgan field, was testing at year-end with definite indications of a substantial addition to the proved productive area.

The big loading jetty on the Persian Gulf has been filling tankers at a record-breaking rate since the Iranian shutdown. Additional berths are being commissioned to handle increased production.

The refinery produces only enough fuel oil to get the tankers to the next supply port because it services some 35 to 45 tankers a week.

KUWAIT NEUTRAL ZONE

American Independent Oil Company and Pacific Western Oil Company, both U. S. independent groups, are continuing exploration activities, including a number of deep wells. No production has been located in this zone between oil-rich Kuwait and oil-rich Saudi Arabia.

MEXICO

Prod. 200,000 b/d Ref. Cap. 229,000 b/d

CIMA, a company composed of U.S. interests, has reported two new discoveries in Mexico. Two U. S. companies have recently entered into 25-year exploratory contracts with Petroleos Mexicanos, The Sharpless Oil Company of Denver, and a California group headed by Edwin Pauley.

Pemex reported 267 wells drilled in 1951 with 400 wells planned for 1952. Five new oil fields and one gas field were discovered in 1951. The most important of these is the Colomo field on Tehuantepec, which is apparently a rich find in high grade oil.

The 155-mile oil pipe line with a 15,000 bbl capacity was completed across the Isthmus of Tehuantepec at a cost of $3,000,000.

MOSUL

This protectorate on the Persian Gulf is an Iraq Petroleum concession. A deep well at Ain Zalah had showings of oil in the deeper zones.

MOZAMBIQUE

Geologic and gravimetric explorations were continued throughout the year by the Mozambique Gulf Oil Company in its Mozambique concession area embracing some 47,000 square miles. (Mozambique is Portuguese territory on the southwest coast of Africa.) Certain indicated structural features were explored by core drilling in the Inhambane-Inharrime area.

A seismograph party is currently being assembled and is expected to arrive in Mozambique soon after the first of 1952. Also a drilling rig is being assembled for shipment with a view to begin exploratory drilling about the middle of 1952.

NETHERLANDS

Prod. 14,000 b/d Ref. Cap. 120,000 b/d

Development of Schoonebeek field by Shell and Standard Jersey results in steady production almost unchanged. This is the largest single field in Western Europe.

At Pernis, near Rotterdam, Europe got its first modern type catalytic cracking in 1951 and became the largest refinery in Europe. Operated by Shell, it has 100,000 bbl a day capacity.

NETHERLANDS WEST INDIES

Ref. Cap. 631,000 b/d

Aruba. North of Venezuela, this island of the Dutch West Indies now has the largest operating refinery in the world since the shutdown at Abadan, Iran. Lago Oil and Transport (Jersey Standard) has more than 400,000 bbl a day capacity. The Shell refinery puts through 31,000 bbl a day at its distillation and cracking plant.

Curacao. Shell reports a 345,500 bbl a day throughput at its Willemstad, Curacao, refinery. This includes crude to cracking units. This is about 50,000 bbl a day greater than the year before. Crude oil still capacity is 200,000 bbl a day.

NEW GUINEA

Prod. 4800 b/d

Exploration is being carried out in western Vogelkop and the island of Salawati.

Klamono field is the only active field in the country and it is holding to steady production by small development drilling. Shell, Standard Vacuum, and Caltex own the concession here.

NIGERIA

Anglo-Iranian and Shell have already spent more than $4,000,000 on exploration work in Nigeria. The first prospective deep well in the country is being drilled near Owerri in the eastern part of the country.

NORWAY

Ref. Cap. 1000 b/d

The Vall refinery was in full operation during 1951 processing SBP naphthas, transformer oil, pale lube oils and asphalts. Completion of lube blending and barreling facilities is expected in 1952.

PAKISTAN

Prod. 3000 b/d Ref. Cap. 5000 b/d

An aerial survey in the east and west is planned for Pakistan by Standard-Vacuum. A test well is being drilled at Sui Dera Bugti in Baluchistan by Pakistan Petroleum, Ltd. This country will get the benefit of intense search for oil resources to make up for the loss of Iran products by Anglo-Iranian.

PAPUA

Australasian Petroleum Company and Island Exploration Company (Vacuum, Anglo-Iranian and Oil Search, Ltd.) continue active prospecting in their permit areas in Western Papua. In addition to further geological surveys, one gravity-meter and two seismic refraction parties operated continuously throughout the greater part of 1951.

Following completion of APC Wana well at 9866 ft as a dry hole, exploratory drilling through 1951 was confined to APC Hohoro No. 2 well near the Vailala River and IEC Omati No. 1 well near the Omati River.

Towards the year's end, the former was approaching 10,000 ft depth while the Omati well was in the vicinity of 9000 ft.

No other company was active in the Territory during 1951.

PERU

Prod. 43,000 b/d Ref. Cap. 37,500 b/d

Seven oil companies in Peru filed a protest with the president protesting certain provisions, which it was thought would hinder development further.

A bill was submitted and passed the Senate authorizing the executive to sue International (Jersey Standard) for more than $40,000,000 claimed in back taxes and interest.

International produces about 80 per cent of the oil and has the largest refinery, at Talara, with a 35,500 bbl a day capacity.

Empresa Petrolera Fiscal, a state oil company, has one rig in operation.

POLAND

Prod. 2200 b/d Ref. Cap. 18,000 b/d

Another Communist satellite is Poland, once large oil producer.

QATAR

Prod. 50,000 b/d

At the end of December 1949 the first tanker was loaded at Umm Said with crude oil from the Dukhan field. Now production has hit 50,000 bbl a day and development continues by the Iraq Petroleum subsidiary, which controls this lease.

Extension wells are reported to show that the field extends some distance south.

ROMANIA

Prod. 91,000 b/d Ref. Cap. 140,000 b/d

A directive, broadcast over the Bucharest radio and reported by United Press, said Romania had failed to meet its goals of oil production or drilling since the properties were seized from Anglo-American interests. The directive blamed "a record number of mechanical breakdowns, accidents, absenteeism, and leaves." It seems, too, the Romanians have been drilling wells without setting up pipe to handle petroleum should they strike oil.

The Romanians praised Russia for sending valuable equipment and technicians.

To overcome the problem, the Romanian government ordered bonuses to workers and more clothing ration cards.

The government also thought the oil workers would take more interest in their jobs if they have titles. Hereafter, the man in charge of a well will be called a brigadier and a man directing a particularly tough job will be called a chief brigadier.

Anglo-Iranian Oil Company agreed to buy 200,000 tons (about 1,400,000 bbl) of fuel oil from Romania for some $2,800,000 to replace fuel oil resources in Iran.

U. S. Oil Imports Up

Total oil imports rose slightly at the end of the week, January 12, compared with totals reported for the week ending January 5, 1951, according to a report by the American Petroleum Institute. Imports totaled 864,200 bbl during the week of January 5, and 879,800 bbl January 12, a slight gain of 15,600 bbl.

The following table includes figures on imports of crude and residual oil as set out by the API:

Week ended	Crude oil	Residual oil	Total products	Total
December 22.....	473,100	409,800	11,500	894,400
December 29.....	434,400	450,200	21,800	906,400
January 5.....	507,700	351,400	5,100	864,200
January 12.....	447,600	398,800	33,400	879,800
4 weeks average..	465,700	402,500	18,000	886,200

SAUDI ARABIA

Prod. 870,000 b/d Ref. Cap. 180,000 b/d

Completion of the 1068-mile, 31-in., 300,000 bbl-a-day tap line from Saudi Arabian fields to Sidon on the eastern Mediterranean permitted a quick rise in production in this concession owned by U. S. interests. It has been in operation a year and has already carried its billionth barrel.

Oil was discovered by Safaniya No. 1, an Arabian American wildcat about 12,000 ft offshore in the Persian Gulf, the first offshore well drilled in this part of the world. This was the ninth oil field in Saudi Arabia.

The Ras Tanura refinery processed an average of 151,280 bbl a day in 1957.

Arabian-American Oil Company signed a new agreement with King Ibn Saud's government in January, which in effect was a 50-50 split in profits from oil. This probably means $150,000,000 for Saudi Arabian treasury.

Aramco is owned by Standard Jersey, Standard of California, The Texas Company (each 30 per cent) and Socony-Vacuum (10 per cent).

SICILY

Gulf Oil Corporation, through its subsidiary, the American International Fuel and Petroleum Company, was granted a research-permit early in the year in southeastern Sicily. Geologic and gravimetric explorations are in progress.

Anglo-Iranian and certain other oil interests are also active in Sicily and carrying on some exploratory work.

SOMALILAND

Geological surveys in this protectorate have not been encouraging.

SPAIN

Ref. Cap. 34,000 b/d

Compañía de Investigaciones y Explotaciones Petrolíferas, S.A. (CIEPSA), a company wholly owned by the Spanish firm Compañía Española de Petróleos, S.A. (SEPSA), drilled a well at La Marina (Alicante), near the Mediterranean sea, which was finished with 5282 ft. This well, only drilled 2890 ft of Miocene sediments and then Triassic fractured limestones until the T.D., was a dry well.

Another well was spudded on July 1951 in the same region, at Rojales, and was drilling the Miocene formations on November, at 4000 ft.

The Spanish oil monopoly, Campsa, drilled a well on a cretaceous structure at Dobro, province of Burgos, in Northern Spain. The structure turned out to

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be an overthrusted fold and only traces of oil in the wealden sands were found. Total depth reached 3936 ft.

In 1952 Ciepsa expects to drill a wildcat in the foothills of the Pyrinean mountain range, in the province of Huesca, and Campsa is going to drill again in the Zamancas valley of the Burgos Province.

The Tenerife Refinery (Canary Islands) of Compañía Española de Petróleos, S.A. (CEPSA), by eliminating some bottle necks and readjusting its installations, has reached during 1951 a capacity of 25,000 bbl per day.

The enlargement of the Cartagena refinery, owned by Refineria de Petróleos de Escombreras, S.A. (REPESA) is going on satisfactorily. Its effective capacity is now of some 9000 bbl per day.

SOUTH AFRICA

Standard Vacuum Refining Company of South Africa plans construction of a refinery at Durban to process crude oil. Estimated cost of the project is about $17,000,000.

South African Coal, Oil and Gas Corporation has announced plans for building a synthetic gasoline plant near Johannesburg, using coal. M. W. Kellogg Company will design and engineer the project, it is reported and Combustion Engineering-Superheater, Inc., will build the boilers to power the plant. Estimated production of liquid fuels is 65,000,000 gal a year.

SUMATRA

Prod. 120,000 b/d Ref. Cap. 138,000 b/d

Sumatra feels the demand for more oil and development of South fields is being pushed.

Caltex has completed more than 14 wells in the Minas field, Central Sumatra, and expects to carry out a large development program in the field and provide a 12-in. pipe line from the field to the river terminal.

SYRIA

Jean Mercier, French geologist, is reported to have found possible large oil deposit beneath the volcanic Harran plateau, on the Syria-Turkey border.

Iraq Petroleum, which holds a concession in Syria, has had discouraging results in exploration.

TRINIDAD*

Prod. 56,500 b/d Ref. Cap. 95,000 b/d

During 1950, the oil industry's exploration program was continued; expenditure on deep drilling amounted to almost $8 million, or more than double the average annual amount similarly spent in the preceding 5 years. Unfortunately no additions to reserves of crude were found.

Seven of the 25 drilling rigs in continuous operation were in use on the exploratory drilling program, and no less than 19 wells with objectives in excess of 8000 ft were in process of drilling during the year.

*Report of Petroleum Association of Trinidad received November, 1951.

Country	Tax as percentage of retail price	Tax as percentage of world market price (c.i.f. main port country of consumption)§
U.S.A.	26	—
Australia	31	61
Switzerland	35	146
Germany	46	231
Sweden	47	155
Belgium	52	178
Netherlands	52	161
Norway	52	205
U.K.	53	186
Denmark	54	189
France	60	293
Spain	69	501
Italy	71	460

§ Based on Low of Platts, f.o.b. plus USMC freight rate from Caribbean.

Table from "Some Economic Aspects of the Oil Industry in 1951." (See Page A-44.)

One of the deepest wells in the Island, drilled by Trinidad Petroleum Development Co., Ltd., at Coora during 1950, has a depth of 13,471 ft. The depth of this well has subsequently been exceeded by a well drilled by Trinidad Leaseholds Ltd., at Morne Diablo with a depth of 14,018 ft. Total annual footage drilled by the industry was 659,565 ft, as compared with 630,209 in 1949.

Production was maintained at the 1949 level, namely, 20,600,000 bbl. The average daily production per producing well, however, again declined, being 25.7 bbl per day.

There were no additions made during 1950 to the main refineries at Point Fortin and Pointe-a-Pierre, but at the latter, work in connection with the new 15,000 bbl a day catalytic cracking plant with associated vacuum distillation unit was commenced. This project is scheduled for completion towards the end of 1952.

Importation of foreign crude for refining or blending and re-export remained at the previous year's level, averaging nearly 1,000,000 bbl per month.

In May 1950, a revised wages agreement, for a 2-year period, was concluded in respect of the employees employed with the oil companies. Labor relations continue to be excellent.

The oil industry continues to contribute over 30 per cent of the Colony's total revenue.

Two licenses were issued during the year in respect of marine areas in territorial waters, one to Antilles Petroleum Company (Trinidad) Ltd. About 12,544 acres and the other to Kern Trinidad Oilfields, Ltd., about 5760 acres.

TRUCIAL COAST

Geophysical surveys revealed a promising structure in the Sheikdom of Abu Dhabi and Petroleum Development (Trucial Coast) Ltd., an IPC associate, is doing some wildcatting there.

TUNISIA

Shell, in partnership with the local French government oil company, spudded its initial test well in the Sousse area about mid-year.

Gulf, also operating jointly with the local French group, was active during the year in geologic, gravimetric, and seismic explorations, and it is anticipated that a drilling location will be selected early in the coming year with a view to spudding the first test well about April 1952.

TURKEY

Prod. 500 b/d Ref. Cap. 1400 b/d

No great change reported in Ramandag field. See Iraq for further news.

UGANDA

Anglo-Iranian and Shell are seeking geological information in this country where they have been offered a concession. Seepages of oil appear in western Uganda. The country is near Lake Victoria in the interior of central Africa.

UNITED KINGDOM

Prod. 900 b/d Ref. Cap. 500,000 b/d

Construction of refining facilities in the last year has more than doubled refining capacity in Scotland, Wales, and England. Largest one is the great Esso Petroleum Company, Ltd., Fawley plant in England, boosted to 130,000 bbl a day crude capacity. Cost was more than $100,000,000.

Capacity of all United Kingdom plants now about equals that of the giant in the Middle East but actual runs to stills have been greater than capacity in recent months. Anglo-Iranian runs at Llandarcy refinery, Wales, are 80,000 bbl a day although capacity is 60,000 bbl a day. Grangemouth refinery, Scotland, with a designed capacity of 36,000 has been running 45,000 bbl a day. The company has doubled the capacity of its plant being built at Kent. Instead of 40,000, it will have a capacity of 80,000 bbl of crude oil a day. Half of this capacity will be ready in early 1952.

Shell's Stanlow refinery with 85,000 bbl a day capacity and Shellhaven with 60,000 bbl capacity will be completed early this year.

The Nottinghamshire fields continue to produce about 900 bbl a day and shale oil output in Scotland ran 2200 bbl a day. Both the crude oil and the shale oil is processed at Pumpherston, Scotland.

Three test wells are being drilled near Formby field by Anglo-Iranian, which operates United Kingdom fields.

URUGUAY

Ref. Cap. 32,000 b/d

The ANCAP refinery at LaTeja has been expanded and includes cracking and production of LP gas.

U.S.S.R.

Prod. 775,000 b/d Ref. Cap. 765,000 b/d

Russia's oil industry minister in December reported to Premier Stalin that the 1951 oil production goal had been reached 3 days ahead of schedule. The figures given above are estimated on the assumption that Russia will reach, or come near reaching, its goal of 60,-

Venezuelan government's income from oil industry versus industry's net income, by years, 1943-1948.
(In millions of dollars)

	1943	1944	1945	1946	1947	1948	Total for period
Received by Government from oil industry							
Royalties	28	44	55	79	128	204	538
Income taxes	7	14	46	53	97	151	368
Import duties	3	4	6	8	11	15	47
Concession taxes	7	11	12	8	8	10	56
Miscellaneous	2	3	4	5	9	11	34
Initial exploration and exploitation taxes	5	13	16	3	1	13	51
Annual exploration taxes	0	2	4	3	2	1	12
Services	3	3	3	4	6	6	25
Total to Government	55	94	146	163	262	411	1,131
Net income of oil industry	32	84	89	143	246	377	971
Excess of Government's receipts over industry's net income	23	10	57	20	16	34	160
Ratio of Government's receipts to industry's net income	63/37	52/48	62/38	53/47	51/49	52/48	54/46

000,000 tons in 1955. This means about 1,150,000 bbl a day production.

Considered one of the best surveys of Russian oil is the book "Erdol in der Sowjetunion" (Oil in the Soviet Union) by Dr. Heinrich Hassman, published in Hamburg, Germany.*

Reports on Soviet petroleum are all indirect, figures and percentages and goals and complaints that appear in the Soviet press and are harvested by patient translators to add to the picture of the economic condition of the Communist nation.

It is reliably reported that wells have been successfully drilled offshore in the Caspian sea. The reports continue that development is being pushed in the interior rather than in the Caucasus area; that the Ural region, the Second Baku, has received the largest attention by the government monoply.

VENEZUELA

Prod. 1,776,000 b/d Ref. Cap. 362,500 b/d

Venezuela is indebted to high demand and Iranian troubles for a booming oil industry. Drilling goes along at about a hundred wells a month with close to half of them in the wildcat and semi-wildcat class.

Production has increased about 200,000 bbl a day since a year ago. See the table for a resume of production since 1947 and the producing companies involved.

Pantepec Oil Company and Clint Murchison have entered a contract for the deep sand development of the El Roble field in eastern Venezuela.

Guasare Oil Company early in 1951 abandoned its deep well, Guasare No. 1 after reaching a total depth of 14,460 ft and making thorough tests.

Most old fields kept fairly steady production with development drilling. Shell's Bachaquero field was producing almost twice the amount it did in 1950, running about 115,000 bbl a day.

Phillips completed a gas injection plant in August at San Roque, Venezuela, is presently injecting 26,000,000 cu ft of gas per day into producing sands with favorable results. Nearing completion is a refinery and wax plant with an expected capacity of 4 to 5,000,000 lb of wax per year, almost half the Venezuelan consumption. An oil stabilization and natural gasoline plant will be competed in January, 1952, to produce 1000 or more barrels per day of natural gasoline from waste gas and stabilize high gravity crude to prevent penalty due to vapor loss.

Sinclair Oil operates a combination pressure maintenance and gasoline plant on its Santa Barbara property processing 31,000,000 cu ft of gas daily and returning approximately 24,000,000 cu ft to the producing formations. A modern refinery of 35,000 bbl daily crude charging capacity was recently completed at Puerto de la Cruz where the company operates its terminal.

Shell expects to complete its Cardon refinery early in 1953 with a capacity of 115,000 bbl a day.

Venezuelan Atlantic Transmission Corporation (Vatcorp), owned principally by Atlantic Refining Company, expects shortly to complete its natural gas line, originating in the State of Guarico, which will serve industrial consumers in the Caracas, La Guaira, Maracay, and Valencia areas. The main transmission line consists of approximately 195 miles of 10-in., 12-in., and 16-in. pipe, and a network of distribution lines and other facilities in the areas to be served, in addition to gathering lines and accessory installations of Venezuelan Atlantic Refining Company in the State of Guarico. It is expected that first deliveries of gas will be made in the near future.

The Mene Grande Oil Company, C. A. increased its pipe line facilities during 1951 and participated in a 30-32-in. pipe line from Palmarejo-Paraguana, which is to be completed in 1952.

YUGOSLAVIA

Prod. 2000 b/d Ref. Cap. 11,000 b/d

If Yugoslavia can use some of her loan from the United States for oil equipment, it may be possible to develop known fields, not yet defined. * * *

*Reviewed with map in The Petroleum Engineer, September 1951, Page B-88.

United States of Venezuela Technical Office of Petroleum, Bureau of Mines: Crude oil production in Venezuela during 1947, 1948, 1949, 1950, and 12 months of 1951. Average in barrels per day.

Companies	1947	1948	1949	1950	Average 1st half 1951	July	August	September	October	November	December	Average 1951
Creole	625,357	683,531	624,505	685,839	763,104	781,043	779,650	778,576	778,088	781,827	804,866	773,663
Shell	331,192	396,990	409,983	461,601	514,226	523,184	519,278	538,072	536,767	556,436	567,933	527,321
M.G.O.	174,604	182,131	169,191	202,211	238,797	248,927	251,420	251,417	253,893	260,398	244,076	245,273
Socony	27,798	30,464	35,951	37,003	46,534	48,843	48,803	53,459	54,494	52,566	54,247	49,319
Texas	8,819	13,278	23,357	25,711	24,524	24,982	22,850	21,917	23,322	18,972	24,251	23,625
Mercedes	169	6,952	15,581	18,706	22,642	23,116	23,709	23,436	24,159	23,939	23,857	23,177
Atlantic	92	3,053	11,692	20,944	20,026	18,549	16,976	17,574	18,341	17,645	18,032	18,932
Richmond	—	765	3,629	12,502	13,899	18,155	17,550	10,256	14,170	9,306	8,865	13,489
Sinclair	21,661	18,469	15,190	12,598	11,779	12,551	13,011	13,331	13,125	13,768	13,272	12,481
Pantepec	—	—	6,274	12,318	10,352	10,013	9,643	9,870	9,137	11,134	8,672	10,042
Phillips	370	1,786	4,852	7,492	6,175	6,787	5,204	6,395	6,392	7,263	7,361	6,371
British	1,157	1,111	1,063	995	958	982	930	943	920	910	954	949
Guasare	5	—	99	65	3	—	—	—	—	—	—	1
Others	254	264	—	—	—	—	—	—	—	—	—	—
Total	1,191,478	1,338,794	1,321,367	1,497,985	1,673,019	1,717,132	1,709,024	1,725,246	1,732,808	1,754,164	1,776,386	1,704,643

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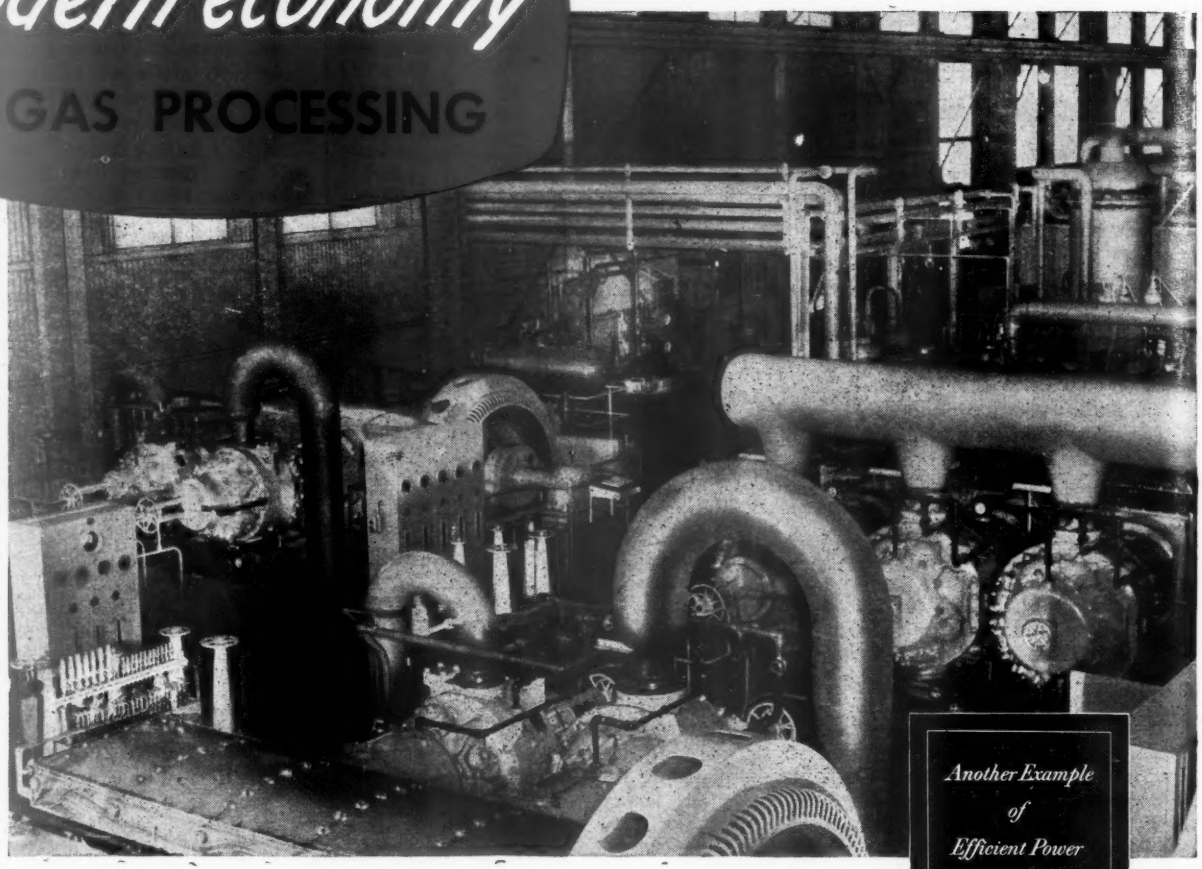

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NEW FIRE CONTROL METHOD

Extinguishment of tank or pool fires is accomplished by using air, oil, or other devices to agitate the oil

JOE L. RISINGER

DURING the past six months a series of tests have been run by Socony-Vacuum Oil Company for the purpose of progressing a novel step in fire control and extinguishment by use of air, the oil itself, or other common agencies and devices to agitate the oil and thus extinguish pools or tanks of oils with flashpoints above atmospheric temperature. In addition, the company is seeking to prevent boil-overs or slop-overs and reduce the intensity of heat of crude oil and other oils with boil-over characteristics, to an extent to enable their easy extinguishment by available methods and agencies. In other words, to control the fire to easy extinguishment.

The process of these tests for extinguishment or control of contained oil fires is the subject matter of an application for patent that is assigned to Socony-Vacuum. It is not the intention of Socony-Vacuum to exact royalties for the use of this method.

The company has not completed research into this process to the extent of the details of application under the various conditions that will be encountered. These are being worked out for our own company. The use of the process by others is of necessity at their own risk, for which Socony-Vacuum accepts no responsibility or legal liability.

The process as tested consists of two separate and distinct parts and objectives:

1. The theory in extinguishment by agitation of oils with flashpoints above atmospheric temperature, such as kerosine, fuel oils, linseed oils, and any other not giving off vapors at atmospheric temperature is based on the fact that fire is fuel in the state of combustion—and fuel is something that feeds the fire. Therefore, when the cold oil from below is caused to take the place of the hot oil at the surface, the vapors are not sufficient to feed the fire, and it is starved.
2. The theory in control of contained crude oil fires and other low flashpoint oils that have boil-over and slop-over characteristics is that the mass of oil is kept at the same or similar temperature by agitation, thus not only destroying heat wave and heat layer, but reducing heat intensity and burning rate to easy extinguishment. If these oils have flashpoints above atmospheric temperatures, they would not only be controlled but also extinguished with proper amount of agitation.

There is no intent in the progression of these steps in fire protection to void or discredit present theories and methods of control and extinguishment of petroleum fires. The objeetive is to further the application of the theory of extinguishment and control by cooling of the substance. In the case of oils with flashpoints above atmospheric temperatures, this method is calculated to provide means of extinguishment with regular operating equipment available at locations where due to the infrequency of tank and other pool fires, heavy expenditures for fixed and/or portable equipment is not justified. In the case of crude oil and other oils with boil-over characteristics, the objective is to eliminate, by simple devices and agencies, these hazardous probabilities, and in addition make extinguishment of such fires possible with much less extinguishing material and equipment, and by use of agencies not now effective on these fires. It is also to make possible the development of special equipment for control of these fires after boil-overs and slop-overs have been eliminated and heat intensity reduced.

The Author

Joe L. Risinger, assistant manager claim and safety department in charge of safety and fire protection of Socony-Vacuum Oil Companies, has been in the oil business since 1919. He began work in the boiler shop of the Beaumont, Texas, refinery of Magnolia Petroleum Company, an affiliate of Socony-Vacuum. He served in various positions with Magnolia, beginning safety and fire protection at Beaumont refinery as early as 1921; and in 1932 was made manager of accident and fire prevention department for Magnolia Petroleum Company and Magnolia Pipeline Company, Dallas, Texas. He went to the New York Office of Socony-Vacuum in 1919.

Risinger is a past member of the board of directors of the National Safety Council, past chairman of the petroleum section of the National Safety Council, past chairman of the central committee on accident prevention of the American Petroleum Institute.

Origin of the Theory

The cooling effect of oils has long been recognized. This we have shown in table demonstrations since their development during the 1920's. In the many demonstrations provided to the Army, Navy, Air Force, and Civilian Defense just prior to and during World War II, small incendiary bombs were burned under oil or extinguished by submerging them into it. In a signed article provided to *The Refiner*, April 1942, photographs show the kindling of magnesium with water and cooling and smothering it to extinguishment by submerging it in kerosine.

The cooling of the hot surface of oils with flashpoints above atmospheric temperatures with the cold oil below, and thus reducing tthe vapors below their burning mixture with air, to feed the fire is the same theory.

Since the close of World War II, our table demonstrations have emphasized the process of cooling the heated oils at the surface below their flashpoints by use of the oil itself and other agencies, and thus starving the fire. In recent months we learn that experiments were started along this line in England during the war, but that the experiments were discontinued as not being the answer to their specific problems. The tests made on this phase of the process are the first known in America, in so far as we can determine, and were completed before knowledge of the abandoned experiment in England.

It was at first decided by management that reports and releases to the press would cover the Olean tests only without tracing back to any ideas that had come to mind on these theories in the past, or work on them. Since the tests at Olean, further interesting facts concern-

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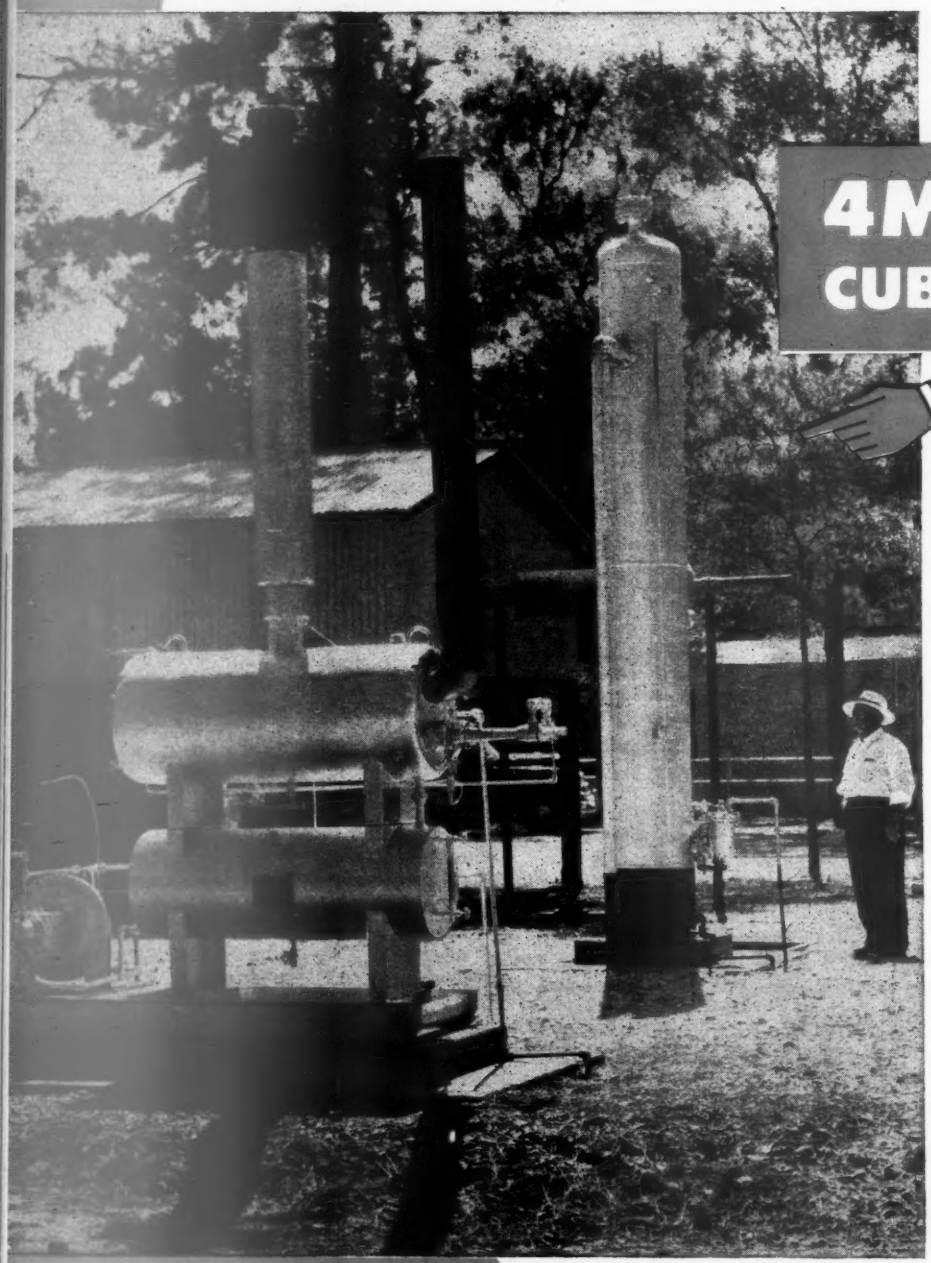

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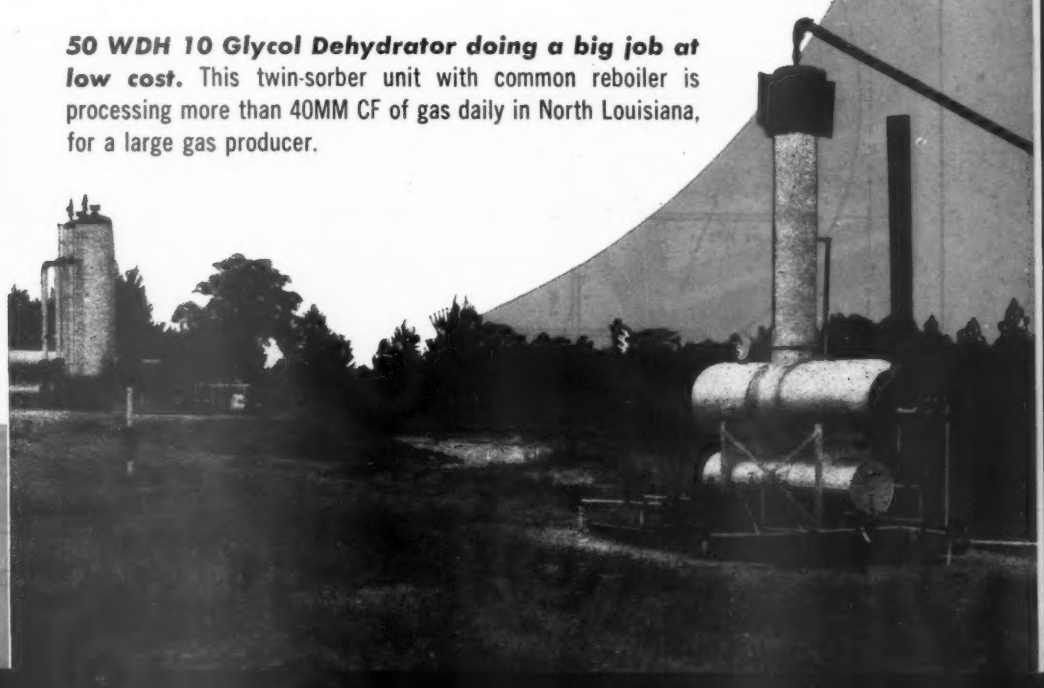
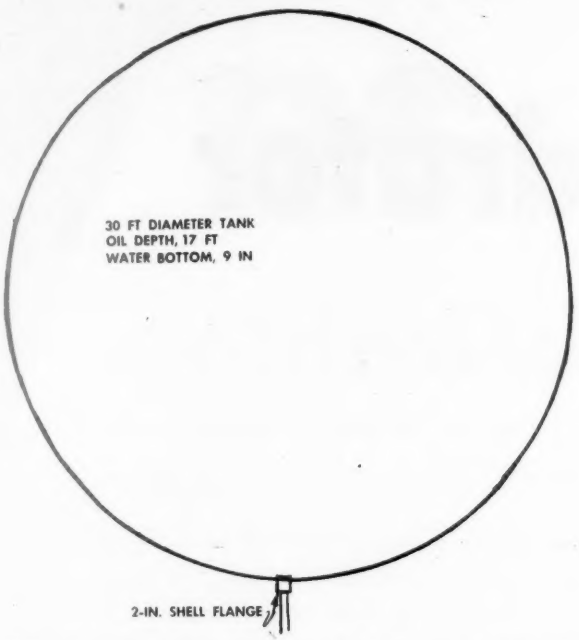
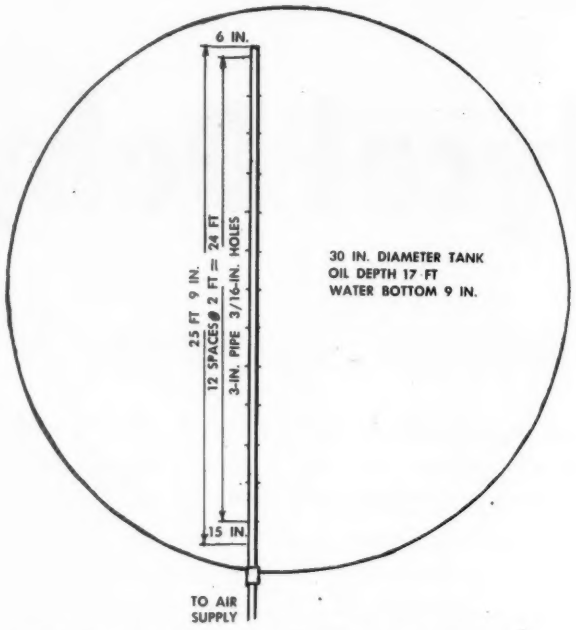




TEST 1. Representing air through 2-in. water draw-off or shell, terminating pumping in line.



TEST 2. Air through 3-in. line across tank.

ing work in the past on the phase of preventing crude boil-overs have come to the forefront. That due credit be given for this work, and because of its substantiating effect on this phase of the tests, it is being included here.

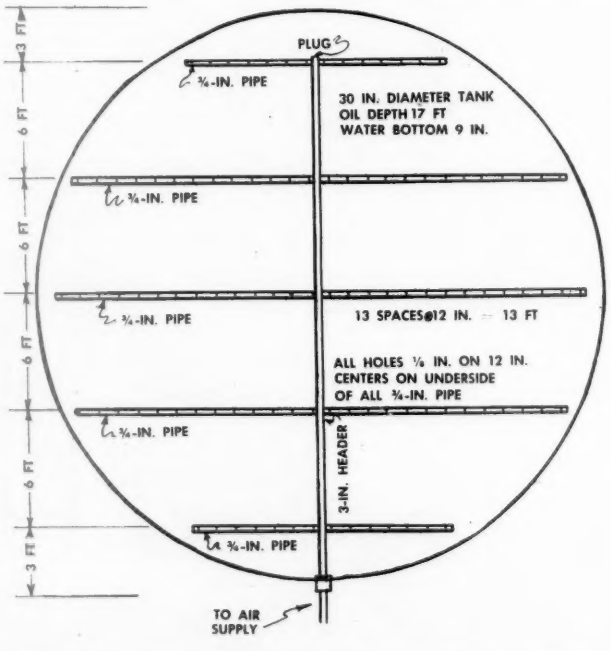
It has recently come to light that some 20 years ago L. B. Leuven developed a spider to be placed in the bottom of the tank. This spider could be used for stirring the oil with air, and thus preventing a boil-over. It is also a handy device for steaming when cleaning the tank.

When before the manufacturing committee of Socony-Vacuum Oil Company, discussing the progressing of the theory of extinguishment and control of oil pool fires by agitation, W. E. Wanner recounted the use of air in a tank during 1928, or thereabout, to prevent a boil-over.

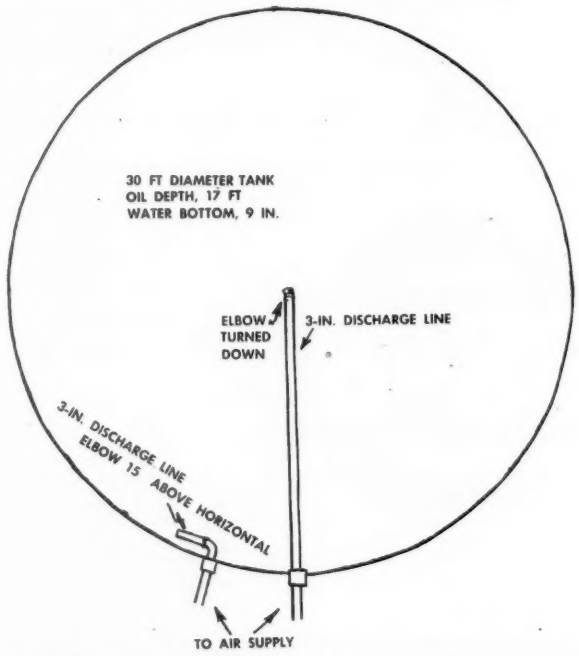
The recent tests at Olean lead through the process of actual extinguishment of oil with flashpoints above atmospheric temperatures by agitation, and then bringing up to date and proving the control of crude oil fires by the same method.

We now have a communication from E. D. Seymour, relating the following use of the theory in actual case of fire at Olean. We are reprinting here excerpts from this communication.

"A fire occurred in a wooden-roofed 70,000 bbl crude tank on the Allegheny tank farm about 1928. It was caused by lightning stroke some 300 ft distant, the tin-covered roof evidently accumulating a static charge,



TEST 3. Air through ¾-in. spider sometimes used as steaming device.


30 FT DIAMETER TANK
OIL DEPTH, 17 FT
WATER BOTTOM, 9 IN.
ELBOW TURNED DOWN
3-IN. DISCHARGE LINE
3-IN. DISCHARGE LINE ELBOW 15° ABOVE HORIZONTAL
TO AIR SUPPLY

TEST 4 and 5. Air through 3-in. discharge ell-shell and (5) air through 3-in. discharge ell-center of tank.

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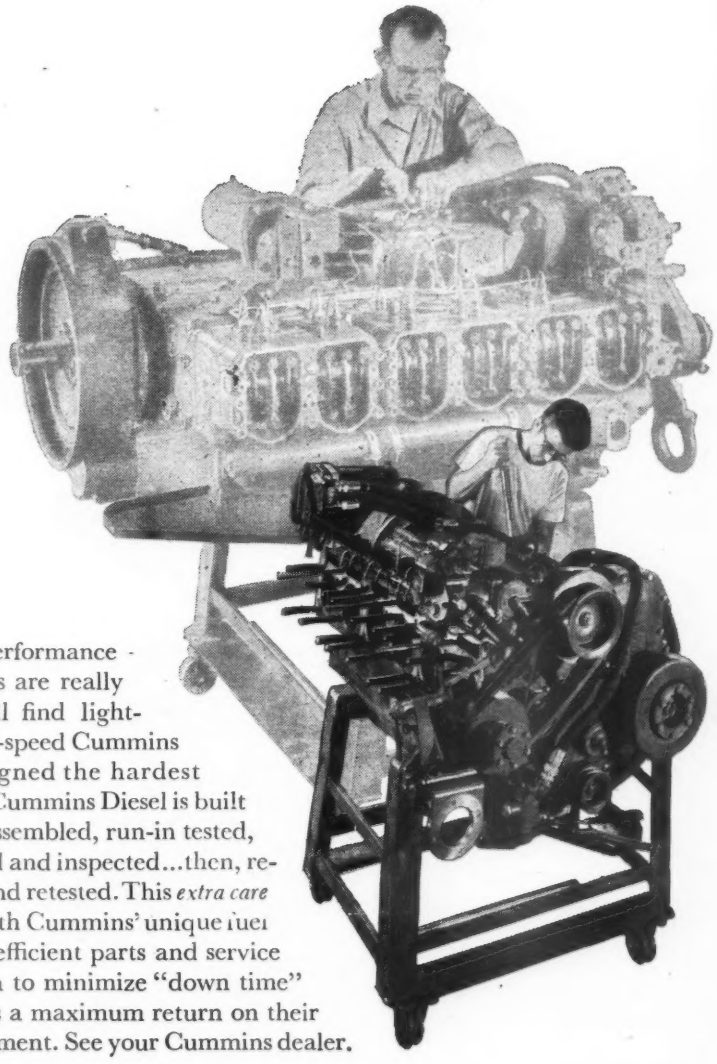

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which, in escaping, ignited escaping vapors at the eaves. Hazardous attempts to smother the then small fires with blankets and tarpaulins were of no avail and the roof was soon entirely aflame, dropping into the burning tank.

"To save as much crude as possible, suction was taken on the tank and in the meantime the small quantity of foam powder available was brought up (I believe it was about 12,000 lb) but with the long hose line required to the Olean main with its 90 psi pressure (Olean had no pumper) the foam proved useless, and the tank burned merrily on. About that time a piece of 'dead wood' plugged the swing pipe and in an attempt to clear same, air was turned into the suction line. A distinct lessening of the fire's intensity was immediately noticeable, so the air was left on. In the meantime arrangements were made for a carload of foam material to be dispatched from Elmira and the loan of Sinclair's pumper from Wellsville obtained.

"When everything was ready the next morning the air was shut off—and then things began to happen! The tank at once boiled over, destroying hundreds of feet of hose and causing everyone to flee.

"L. B. Van Leuven, of the Vacuum Oil Company's manufacturing committee, was so impressed with the results of introducing air into tanks containing volatile liquids that he obtained authority for the necessary funds to conduct some experiments at Paulsboro, with which the undersigned was charged.

"An old open-top slop tank, about 30 ft diam by 20 ft high, was rigged with an air spider as well as a swing suction into which air could be introduced. A wooden tower of sufficient height to permit a view of the tank's interior was erected to windward, tank was painted with heat indicating stripes of SOCAL's formula, the plant fire department briefed, and after filling tank to about the 7 ft mark with a volatile slop oil with plenty of water in suspension, the contents were touched off, and allowed to burn for some time.

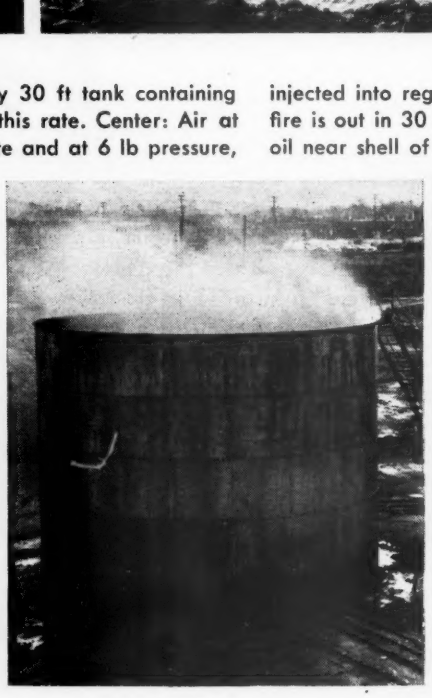
"When the indicating stripes showed that the heat wave was commencing to descend at an accelerating rate, the air was turned into the spider. Combustion then appeared to take place above the tank top where the now rich mixture could obtain the requisite oxygen to support combustion, and at the same time it was observed that the heat wave descent ceased. Foam was then applied and in a short time the fire was extinguished. A record of the quantity of dual powder utilized was made a matter of record.

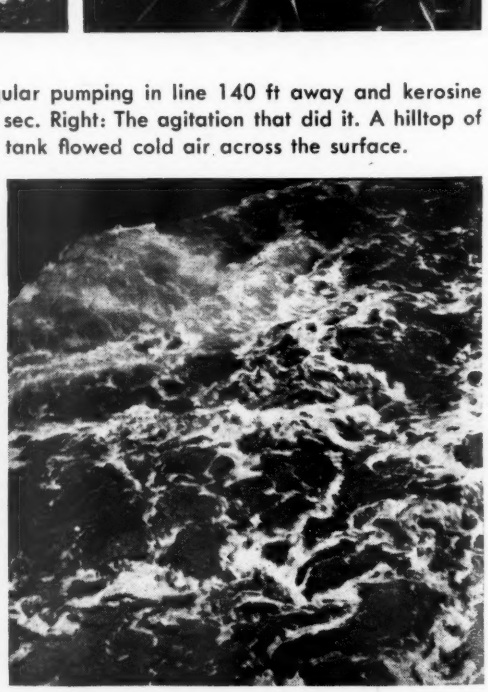
"After luncheon the tank was again ignited and air through the swing suction at once introduced. To the surprise of all, the fire went out. When the fire was permitted to burn for several minutes, causing the shell plates above the surface to become very hot, however, the flames rose well above the tank top except around the edge where the hot shell kept the gas ignited. Foam was again applied and in half of the time, and with a fraction of the foam previously required, the flames were extinguished.

"The tank was again ignited and on this occasion an initial boil-over was permitted before air was introduced through the swing suction. Further boil-overs were prevented and the fire once more extinguished with foam."

TEST 1. Left: The fog nozzle is lowered into flaming pool of kerosine. Center: By bringing cold kerosine from below to the surface to replace hot oil at surface, kerosine fire is out immediately. After the pit fire was tested Joe L. Risinger, left in third photo, directs W. E. Wanner, Olean superintendent, in igniting first fire in large tank, while Archer Ashton, supervisor of safety and fire protection, Paulsboro refinery, lends an assist.

Left: First kerosine underway in 30 ft by 30 ft tank containing 100,000 gal. It burned two minutes at this rate. Center: Air at the rate of 50 cu ft of free air per minute and at 6 lb pressure, injected into regular pumping in line 140 ft away and kerosine fire is out in 30 sec. Right: The agitation that did it. A hilltop of oil near shell of tank flowed cold air across the surface.





TEST 5. Left: It was necessary to add gasoline each time to cause kerosine to ignite in mass. Center: engineers check this one closely on time at start of their kerosine fire. Right: The 100,000 gal kerosine in 30 ft by 30 ft tank really got underway in 2 min.

Much credit is due to all who have had similar or the same ideas on the control of oil fires as that tested at Olean November 13 to 15, 1951. We are progressing the method in the interest of our own company, the oil industry, and anyone else who may be confronted with the problem of fire extinguishment and control in petroleum products and other similar oils.

Recent Large-scale Tests

The tests from which photographs were taken were held at the Olean refinery of Socony-Vacuum Oil Company, November 13 to 15, 1951.

The props used in these tests consisted chiefly of:

One 30 by 30 ft tank equipped with devices, lines, and valves, already found in tanks such as water draw-off, product line, and devices for steaming bottoms or stirring oil.

1. 100,000 gal of kerosine distillate, with a flashpoint of 126 F.
2. 100,000 gal of crude oil API gravity 44.2 flashpoint below zero.

One 8 ft diameter pit to contain refined product with a flashpoint of 126 F.

One ¼ in. pipe bent so as to inject oil or air under oil.

Hand pump containing 5 gal kerosine.

Two 55 gal drums open-top containing crude oil into which foam to be shoveled after heat wave had started traveling downward to demonstrate slop-over.

High-powered air compressor and lines.

One inch air lines were attached to larger lines 140 ft distance from the tank. Air was measured by flow charts and pressure gages, and regulated by a one inch valve. Although air pressure showed to be from 6 to 10 lb, it is calculated that the back pressure of oil was such that there was practically no air pressure at the point where the air was released into the tank.

Test of Extinguishment of Oil With Flashpoints Above Atmospheric Temperature

To test the process of extinguishment of contained fires in oils with flashpoints above atmospheric temperatures, kerosine distillate was used.

Analysis of the kerosine distillate was:

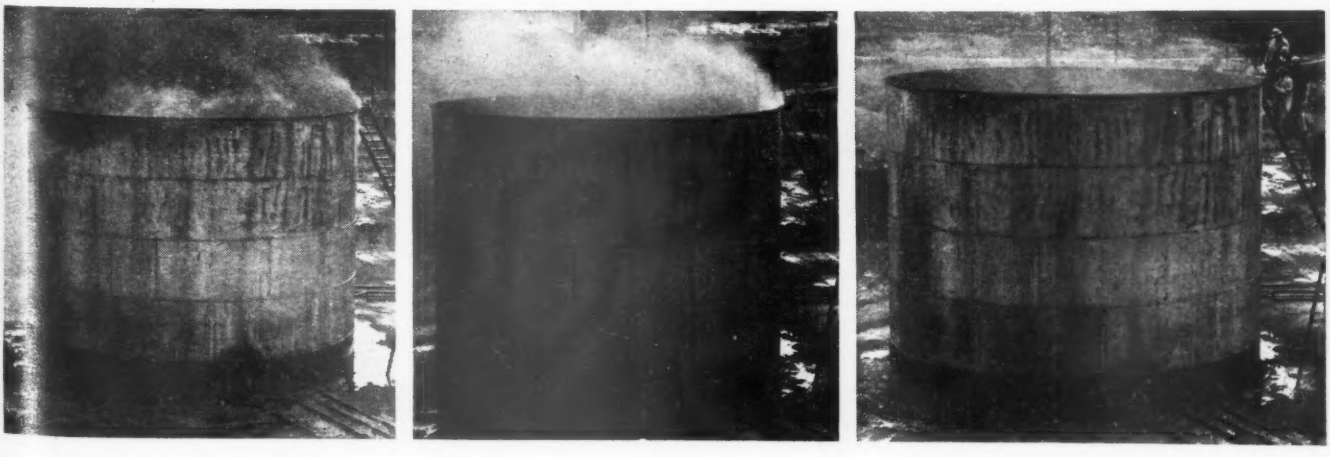
Analysis of kerosine distillate used in tests

Gravity API	47.4
Specific Gravity	.7909
No. 1 gal.	6.585
Distillation	
IBF °F	334
10%	356
50%	400
90%	468
FBP	522
Saybolt Color	9
Saybolt Thermo Viscosity	326
Flash °F Tag	126
Pour below –	30
Reid Vapor Pressure	0

To demonstrate the theory:

1. The 8 ft pit of kerosine was ignited and principles of cooling surface below the flashpoint of the oil by circulating oil from sub-surface to replace heated surface was illustrated by extinguishing the fire with 5 gal of the same oil injected into the surface of the burning oil by use of a hand pump.
2. Further demonstration of the theory was tested by application of kerosine in ¼ in. stream and also injection of air at bottom of pit through ¼ in. line.

Left: When air entered center of tank at bottom through pumping in line, fire was completely converted to smoke only within five seconds. Center: As the smoke blew away from surface of this kerosine tank fire, extinguished in five seconds with air, there was no indication of fire left. Right: Inspection by those in attendance including Buffalo showed complete success of kerosine fire extinguishment by agitation, in this case in five seconds.



Although we do not recommend the promiscuous squirting or throwing of oil on oil fires, especially by the uninitiated, the theory was here illustrated in the same manner as can be done by the placing of the nozzle of a goose-neck fog nozzle under the surface of an oil with flashpoint before atmospheric temperature.

Test on 30 by 30 Ft Tank

The tank was filled to approximately ¾ capacity with the kerosine distillate. It contained a 9 in. water bottom and approximately 18 ft of kerosine distillate. The amount of distillate being approximately 100,000 gal. There was an approximate 7 ft freeboard on the old tank, the thickness of steel of which was approximately 50 per cent of the original.

Five tests were run by the method of agitation by use of air. Inadequate pumping facilities did not permit of tests by use of the recirculation method of agitation. In all cases approximately two minutes preburn was allowed.

Test No. 1. Air in at water draw-off. (See Chart).

In this test, air was injected into the tank through the water draw-off at a rate of 50 cu ft of free air per minute through the 1 in. valve 140 ft from tank at 7 lb pressure. A preburn from time of ignition to the time air entered the tank was 1½ minutes. The time of extinguishment was 30 seconds. Air entering the tank during the extinguishment 25 cu ft at 7 lb pressure. The movement of the oil that extinguished the tank was a bulge in the surface next to the shell of the tank where the air came up. From this bulge, the cold sub-surface oil flowed across the tank to the opposite shell. The fire was out by the time the cold oil travelled completely across the 30 ft surface to the opposite shell of the tank. Although the previous day this was determined as a minimum for a starter, in the actual test indications were that even a smaller rate of flow and pressure would have extinguished the tank fire. The amount of air used during extinguishment was about equal to a 24 gal tank or cylinder of air at 100 psi.

Test No. 2. Straight perforated pipe across bottom of tank. Shown in chart.

Air was injected through a 2-in. pipe containing ⅛-in. holes—two feet apart —in pairs on each side of the line and downward. The turbulence decided upon the previous day for a starter was 55 cu ft of air per minute at 10 lb pressure. In the test this proved more than was necessary. The tank was ignited and a preburn of two minutes allowed. From the time the air entered the tank to the time of extinguishment was 35 seconds. The total cubic feet of air entering the tank during the extinguishment was 30 cu ft. Indications in this test were that air leaving the pipe near the shell had extinguished the fire before the line completely across the tank to the opposite shell had been completely freed of product by the air.

Test No. 3. The Van Leuven spider. Shown in chart.

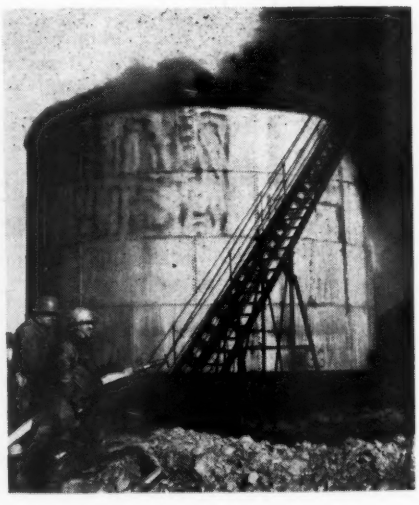
In this test a preburn of two minutes was allowed to the time air entered the device at the inside shell of the tank. The air rate was 40 cu ft per minute at 6½ lb pressure. The fire was extinguished in 20 seconds, with a total of 14 cu ft of air during the time of extinguishment at 6½ lb pressure. Indications in this test were that the tank was extinguished long before the complete spider had been cleared of the product by the air pressure. Conclusions are that so extensive a device is not required, but if already in tank, it is very effective.

Test No. 4. Regular shell ell.

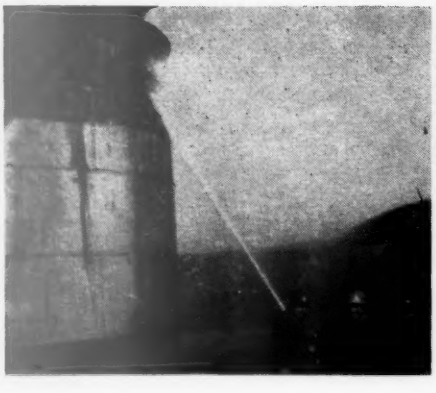
In this test the regular inside shell ell was used for circulating the oil out of the tank and back into it. Pump pressure and lines (chiefly suction lines) being too small, and the suction line and the ell being very close together—not enough circulation was developed to extinguish the fire. This caused a preburn of two minutes and 35 seconds when air was switched into the shell ell at a rate of 90 cu ft per minute, and the fire was extinguished in 45 seconds with 68 cu ft of air at 6 lb pressure.

Although this was not considered to be a true test, conclusions were that the air injected through the shell ell gave a circulating and turbulent motion around the shell, and did not cause as rapid extinguishment as when line terminated at bottom of shell and caused cold oil to rise at that point and flow across the surface, it being a greater distance

CRUDE OIL TEST. Left: Blazing tank of 100,000 gal of crude oil before turbulence has been introduced in product. Right: When agitation is induced into burning oil, fire is not extinguished but reduced to tank shell in seconds.



Left: Tank of crude oil is still on fire but cannot be observed above edge of tank when agitation is induced. Firemen cool platform at top of tank so that spectators can go up and look into tank. Center: What spectators and photographer saw at the burning surface of the 100,000 gal of crude oil. Right: A. R. Taylor, Socony-Vacuum Oil supervisor of safety and training, Carracas, Venezuela, does something never done before, attacks a 30-ft tank of crude oil on fire, from top platform with hand extinguisher.



STATEMENT OF CONDITION

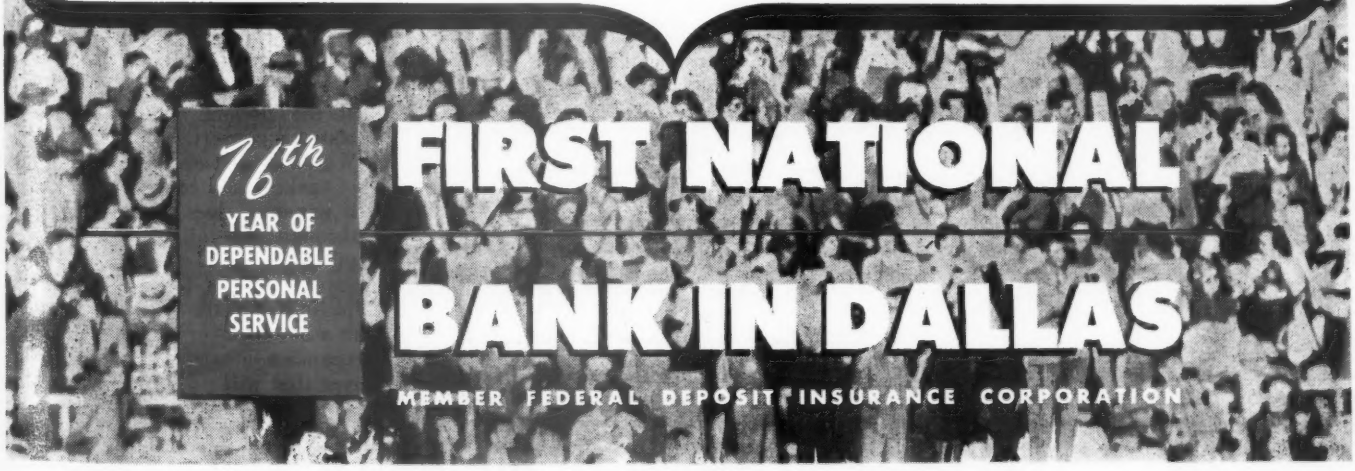
at the close of business December 31, 1951

ASSETS

Cash on Hand and Due from Banks	$210,215,820.03
United States Securities Owned	121,274,575.20
State, County and Municipal Bonds	11,512,534.63
Stock in Federal Reserve Bank	720,000.00
Other Bonds	73,100.00
Loans and Discounts	194,758,349.94
Income Accrued	995,325.33
Letters of Credit and Acceptances	8,897,444.25
Banking House and Equipment	3,841,393.55
Other Assets	28,001.00
	$552,316,543.93

LIABILITIES

Capital Stock	$12,000,000.00	
Surplus Fund	12,000,000.00	
Undivided Profits	4,348,565.58	$ 28,348,565.58
Reserved for Contingencies		3,152,091.96
Reserved for Taxes, Etc.		3,297,718.31
Interest Collected not Earned		315,766.58
Letters of Credit and Acceptances		8,897,444.25
DEPOSITS		
Individual	$289,348,372.38	
Banks	207,854,550.16	
U. S. Government	11,102,034.71	508,304,957.25
		$552,316,543.93



around the shell than straight across the tank.

Test No. 5. Pumping in line with ell at center of tank (chart). (See photographs).

This test was really the one that paid off, and the results were unbelievable. Records have been checked, however, by the several engineers operating the valves and keeping them. The air through the 1 in. valve was turned into the simulated product line leading to the center of the tank with ell turned down, sometimes used for stirring up the bottoms and cutting down product loss in gaging. The tank was allowed a preburn of 2½ minutes—allowing the 30 seconds for the lag for the air to displace oil in the line. From the time air actually entered the tank to the time of extinguishment was only 5 seconds. As the air was entering the tank at a rate of 75 cu ft per minute at 6 lb pressure, it is calculated that only 6¼ cu ft of air actually entered the tank during the time of extinguishment. This was about equal to a 6 gal drum of air at 100 lb pressure.

The conclusion as to the reason for such quick action in this case was: The air was forming a bulge in the center of the tank from which cold oil was flowing in all directions towards the shell and thus was required to flow only 15 ft at the maximum to extinguish the fire.

Calculated on this basis, air entering at the center of an 80 ft diameter tank would need only to cause a flow of cold oil across the surface—a distance of 40 ft. Thus, only 10 ft further than necessary from the water draw-off across the 30 ft tank.

The general conclusions from the kerosine tests are:

1. Tank fires in unheated oils with flashpoint above atmospheric temperature can be extinguished by causing a turbulence that brings the cold sub-surface oil to the surface, thus replacing that heated sufficiently to give off vapors at a rate sufficient to feed the fire.
2. That this agitation can be caused by the injection of air into the various bottom lines of a tank. The most effective being at the center of the tank, thus causing a shorter distance to all sides of the shell.

Control of Contained Crude Oil Fires

Crude oils and other oils containing boil-over and slop-over characteristics may also have a low flashpoint. Thus the tests here were not directed toward extinguishment but control. Heavy oils that might have boil-over and particullarly slop-over characteristics, having a flashpoint above atmospheric temperature, would not only have these characteristics removed from them by agitation but would be extinguished.

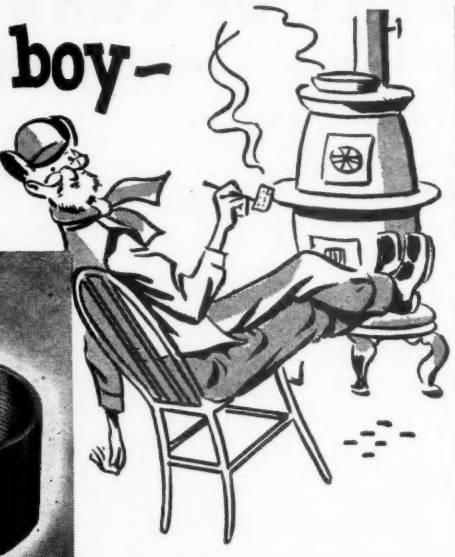
The problem of preventing large bodies of crude oil and other oils with boil-over characteristics from boiling over or slopping over when on fire has long been a serious one. It had been determined by previous small-scale tests that pools of crude oil can be successfully prevented from boiling over or slopping over by causing a movement of the oil itself in a manner to disturb the heat layer and heat wave.

Boil-overs occur in these oils when a heat wave from the burning surface travels down through the oil to the water in the bottom of the tank or suspended in the oil; this water is converted to steam; the steam cannot travel readily through the viscous oil above and, therefore, pushes it out of the tank. Three things are necessary to have a boil-over.

1. A viscous oil with a wide boiling range.
2. Heat wave caused by burning away of the light hydrocarbons and heating of the larger and heavier hydrocarbons, which drop down a distance into the cooler oil and then heat it. When they have carried out this course sufficiently to reach the water suspended, or at the bottom of the tank, the water is converted to steam.
3. Water in suspension or at bottom of tank. When converted to steam it expands, does not pass readily through the oil and, therefore, pushes it out of the tank.

The application of foam or water, except sparingly, to the surface of crude oil with a hot oil layer causes a frothing and expansion at and near the top of this layer that will push an amount out of the tank, similarly as will steam push out a greater amount as it comes from

"Since I was a boy—darned near..



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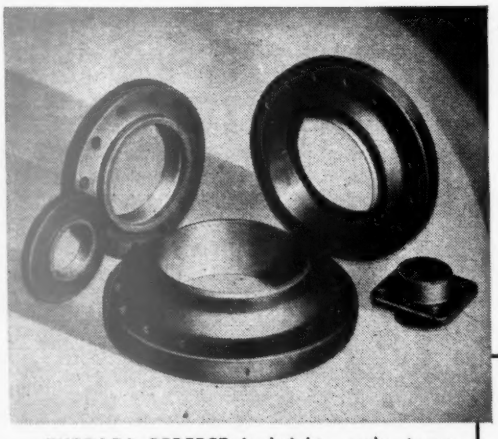

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bottom of a tank. This is a slop-over.

It had been determined by previous small-scale tests that pools of crude oil can be successfully prevented from boiling over or slopping over by causing a movement of the oil itself in a manner to disturb the heat layer and heat wave. Tests had shown that air injected into the bottom of the tank by special devices would set the crude oil in motion in a manner to disturb the heat wave and/or submerge the heat layer by replacing them with the cooler oil below. In these cases the heat wave was not only disturbed and boil-over and slop-over hazards killed, but the intensity of heat was reduced several times, and likewise the rate of burning. The problem here is one of using lines and devices already in the tanks or that can be installed at little expense, will not readily clog up, and heavy maintenance is not involved. Some of these devices can be used effectively for steaming or cleaning purposes, ever guarding against static induced fires.

In this case, the required amount of agitation is all that is to be sought.

Analysis of crude stock used in fire test at Olean refinery

Gravity API		44.2
Gravity Specific		.8054
Lbs./Gal		6.705
SUV @ 100		35.04
Pour	Below—	30
Flash	Below—	0
Distillation		
IBP °F		132
10%		248
50%		450
78% (Cracked)		660

As the intentions were to test the various injections of air to control and eliminate slop-over and boil-over hazards and not to extinguish completely, switches were made without extinguishment.

Crude Oil Fire Control Tests

Before beginning the tests on the large 30 by 30 ft tank, the theory of slop-over was demonstrated by the use of a 55 gallon drum. The crude oil in this drum was allowed to burn for 30 minutes, until the heat wave had started travelling downward. The fire was then extinguished by placing a sheet of steel over the drum and extinguishing it. Foam was then placed in the drum by use of a long-handled shovel. It may be observed that slop-over occurred immediately. Had the drum been allowed to continue burning until the heat wave reached the water in the bottom, this water would have been converted to steam and a large portion of the burning oil pushed out of the drum. (See photograph of crude drum slop-over.)

The same lines and devices were used in crude oil tests as on kerosine distillate except for the shell ell, which was not used.

TEST NO. 1. Water draw-off.

The crude oil tank was ignited and allowed a preburn of one minute. Air was then injected through the water draw-off at rates from 50 to 100 cu ft of air per minute at 6 lb pressure. The flames were checked within 45 seconds, but through this device were never brought down below the rim of the tank there being an approximate 7 ft free board above the liquid level.

The fire was allowed to burn in this manner for approximately 5 minutes. It was very evident from this test that the boil-over and slop-over hazards had been eliminated and the fire reduced to control, so that fire fighting equipment could be brought into play to extinguish the fire. The flames were held to this and still further reduced during the period of five minutes.

TEST NO. 2. Perforated pipe across center of tank.

Air was cut off of water draw-off for 45 seconds to allow flames again to reach their uncontrolled height. Air was then turned into pipe across center. Within 45 seconds, flames were brought down within the 7 foot free-board with intermittent wind-swept flames above the rim. This required from 22 to 30 cu ft of air per minute at 7 lb pressure. This controlled condition was held for about three minutes.

TEST NO. 3. Spider in tank.

Air was switched from perforated line across tank to spider at 90 cu ft per minute and 7½ lb pressure. Flames immediately came down to within free-board, so that very little smoke was noticeable. The air was continued on spider for 20 minutes and 15 seconds. During this time, after stairway platform was cooled, surface flames were inspected — photographs and movies taken and visitors looked at them, all

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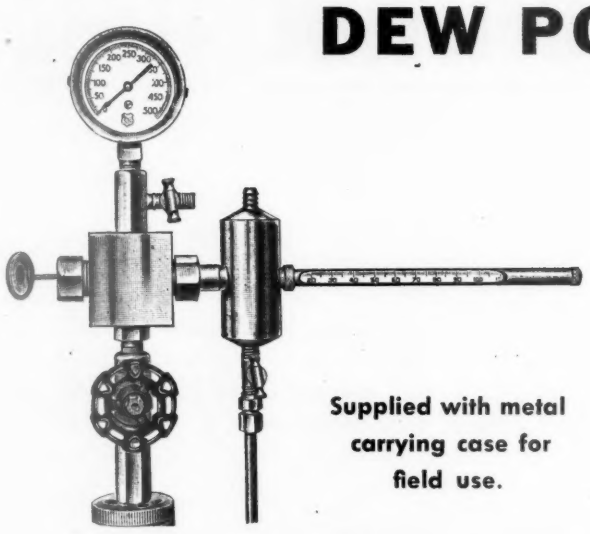

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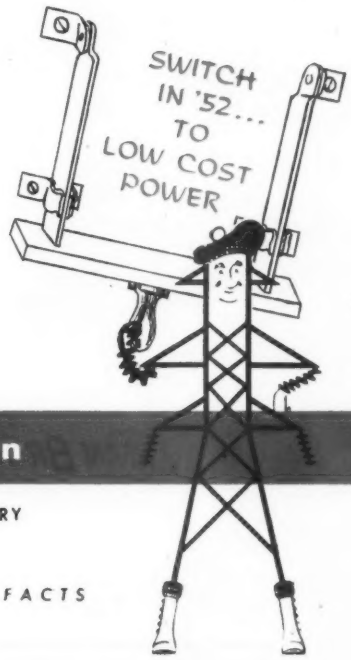

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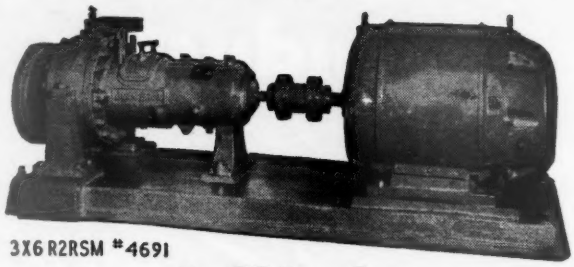
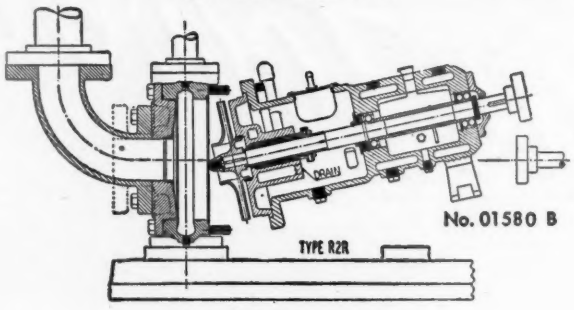


Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R processs pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
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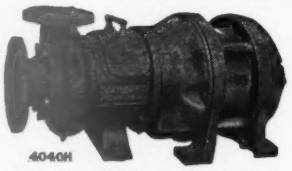

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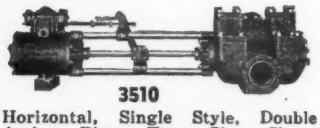

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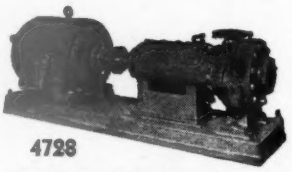
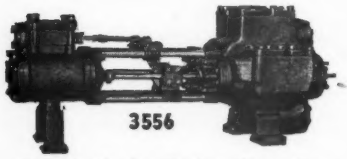
Pedestal Mounted Centrifugal Pump

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump



Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

from stairway platform at top of tank. Some leaned over rail above tank to look straight down. An attempt was made to extinguish with two 30 lb dry chemical extinguishers.

TEST NO. 4. Spider and ring.

The purpose of this test was to determine whether two devices would perhaps reduce flames further. They did not.

TEST NO. 5. Spider in tank.

Air was again placed on spider to determine any change in burning rate since its use over ¾ hour before. There was none; and again pictures were taken and inspections made from tank platform. Spider was kept on and preparations to extinguish with one 1½-in. mechanical foam nozzle.

Extinguishment of the Crude Oil Tank

Over two hours from time of ignition, air was again turned in through the spider. While the fire was controlled by the air through the spider, National Foam Company's sales manager went up on the stairway platform of the tank and with a 1½-in. mechanical foam nozzle and foam of not 100 per cent quality (because of the lack of water pressure in the foam maker) applied foam on the surface of the oil. He used only two pails of mechanical foam liquid and extinguished the fire completely within five minutes.

The tank had been allowed to burn uncontrolled at short intervals, but essentially under control for well over two hours, during which time the heat intensity was also reduced to the extent that the thin 7 ft free-board shell of the old tank did not buckle or melt.

Heat wave in this crude oil would travel approximately 48 in. per hour. In this case, the heat wave would have travelled 100 in. or 8 ft 4 in. during the tests. The heat detecting paint showed that the heat wave did not travel downward during time of any agitation whatsoever. Preburns allowed a travel of approximately ½ in. below liquid level.

When extinguished, the foam caused no frothing or expansion whatsoever. It lay on the surface of the oil in the same manner as it would have on the surface of a crude oil with 83 F temperature that had not been ignited. The temperature of the crude was the same throughout the mass. The change in temperature of the crude was from 50 F to 83 F.

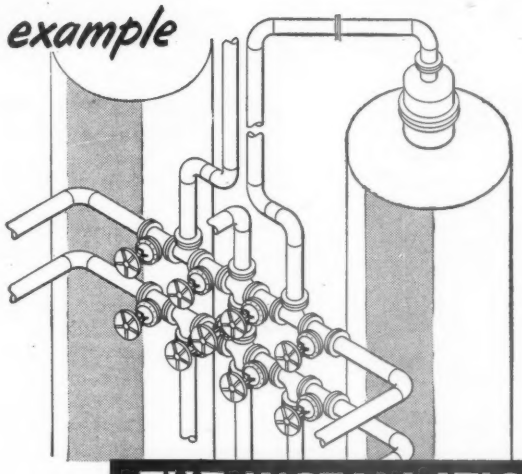
Tests of Process to Continue

The Socony-Vacuum Oil Company intends to progress this process by further tests and research. Not for its own benefit alone but in the hope of assisting others in fire extinguishment and control, and in the reduction of the hazards and discomforts that might be involved when the vapors from a tank or pool of oil are on fire. In the meantime, reports of the tests only are provided. When tests of recirculation have been made, information on them will be provided. * * *

Are You Getting Valve Satisfaction?

Like this Refinery

for example



THE INSTALLATION

Nine Crane valves on control manifold to reaction chambers on Perco Cycloversion Unit. Bareco Oil Company, Wichita, Kansas.

VALVE SERVICE RATINGS

SUITABILITY:	Matches service needs
MAINTENANCE COST:	None to date
CORROSION-RESISTANCE:	O.K.
SERVICE LIFE:	Now more than 2 yrs.
OPERATING RESULTS:	Valve leakage stopped
PRICE:	In line
AVAILABILITY:	Local Crane supplier

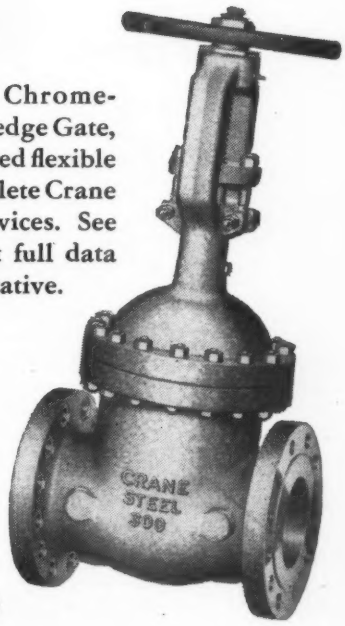
THE HISTORY

Valves formerly used would not stay absolutely tight as necessary. Down time for repairs was excessive. Fluids handled: At oil inlet, straight run gasoline at 950 Deg. F., 85 psi; for catalyst regeneration, air-steam mixture at 850 Deg. F., 15 psi; regeneration waste gases, 1200 Deg. F. at 5 psi. Approximately 15-day cyclic operation.

Replacement made with Crane Valves. After more than 2 years' service, with no maintenance required, all Crane Valves are absolutely tight and operating at highest efficiency.

THE VALVE

Crane 300-Pound No. 5 Chrome-Molybdenum Alloy Steel Wedge Gate, with Stellite seats and patented flexible disc design. One of the complete Crane steel family for refinery services. See your Crane Catalog or get full data from your Crane Representative.



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More Crane Valves Are Used Than Any Other Make!

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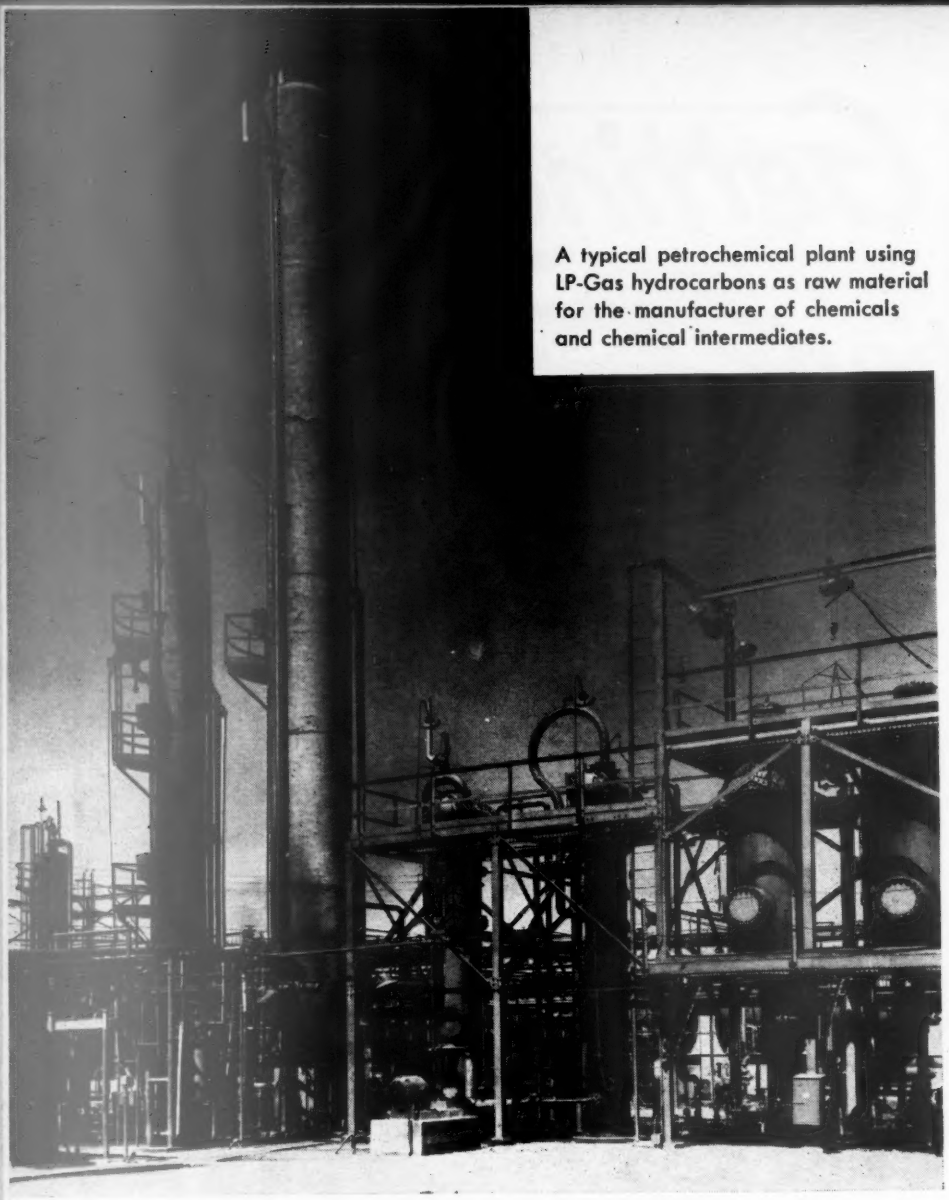


A typical petrochemical plant using LP-Gas hydrocarbons as raw material for the manufacturer of chemicals and chemical intermediates.

Demand for LP-Gas Rises Sharply in 1951

K. W. RUGH and GEORGE R. BENTZ

THE steady but rapid growth and expansion of the liquefied petroleum gas industry continues unabated as it has since its progress was first summarized in early 1929. Sales of LP-Gas in 1951 reached an estimated 4,100,000,000 gal, exclusive of any product used in the manufacture of aviation and motor gasoline or synthetic rubber. This is an increase of 25.9 per cent over 1950. The gallonage increase of 846,000,000 gal is almost equal to the total sales of 1944.

The demand seems insatiable. Shortages in winter are apt to be felt again, especially if colder-than-normal weather occurs. Secretary Chapman urged "summer storage fillup". The industry entered this winter with its storage in better shape than a year ago. The picture appears brighter for 1952.

The industry is once again beset with material shortages and resultant allocations and by price regulations on its products and supplies.

The LP-Gas industry ranks as one of the major suppliers of energy in the country and is contributing much to the health, welfare and convenience of millions of people. It is viewed by many as the fastest-growing segment of the petroleum industry and one of the fastest-growing industries in the country today.

Change in Reporting Method

With this report, the writers are making a change in the method of reporting LP-Gas sold for fueling internal combustion engines. This change brings under one heading—"Domestic and Motor Fuel"—all LP-Gas sold directly by producers and marketers as direct motor fuel plus all LP-Gas sold by *distributors*.

Prior to 1951, LP-Gas sold direct by producers and marketers to consumers using it *solely* for fueling internal combustion engines was reported under the "Industrial and Miscellaneous" heading. LP-Gas sold by domestic distributors but ultimately used as internal engine combustion fuel was reported under the "Domestic" heading.

This change is reflected both in the text and in the table, "Marketed Production of LP-Gas".

Domestic and Motor Fuel Use

Sales of LP-Gas for domestic and motor fuel purposes are estimated at 2,868,000,000 gal in 1951. This represents an increase of 32.5 per cent over 1951 sales in this category, and far exceeds the total sales of the entire industry in 1949.

Weather conditions throughout the country played an important role in domestic and motor fuel sales during 1951. The extreme cold experienced in most parts of the country during the early months of the year added greatly to consumer demand for heating purposes. Colder than normal weather in the fall and early winter of 1951 likewise increased the LP-Gas heating load. A long dry spring and summer in sections of the southwest greatly increased the demand for LP-Gas as a fuel for irrigation pumps. Conversely, extended rains and serious floods in many sections reduced the sales and deliveries of LP-Gas in those areas. Increased sales in this category of 704,000,000 gal over 1950 clearly show, however, that domestic and motor fuel use of LP-Gas are continuing their phenomenal rise.

During 1951, an estimated 470,000 ranges were produced specifically for use with LP-Gas. An additional large volume of ranges produced for other gases were adaptable with only minor changes to LP-Gas, and undoubtedly many were connected to LP-Gas instal-

The Authors

K. W. Rugh, assistant sales manager, of the Phillips Petroleum Company.

George R. Benz, manager, engineering department, Phillips Petroleum Company.

MARKETED PRODUCTION OF LP-GAS

Year	Total Sales: Gallons In Thousands	Total Sales: Per Cent Increase	Distribution — 1000 Gal.: Domestic and Motor Fuel (1)	Per Cent Increase	Ind. and Misc. (2)	Per Cent Increase	Gas Mfg.	Per Cent Increase	Chemical Mfg.	Per Cent Increase
1922	223	..								
1923	277	24.4	**Sale of Liquefied Petroleum Gas Confined Primarily to Bottled Gas Business Prices to 1928**							
1924	376	36.0								
1925	404	7.2								
1926	465	15.2								
1927	1,091	134.6								
1928	4,523	314.6	2,600	..	400	..	1,500	..	..	..
1929	9,931	119.6	5,900	126.9	1,500	275.0	2,500	66.7	..	..
1930	18,017	81.4	11,800	100.0	2,200	46.7	4,000	60.0	..	..
1931	28,770	59.7	15,295	29.6	7,172	226.0	6,303	57.6	..	..
1932	34,115	18.6	16,244	6.2	8,167	13.9	9,703	53.9	..	..
1933	38,931	14.1	16,626	2.3	13,987	71.3	8,318	-14.3	..	..
1934	56,427	44.9	17,681	6.3	32,448	132.0	6,298	-24.3	..	..
1935	76,855	36.2	21,380	20.9	47,894	47.6	7,581	20.4	..	..
1936	106,652	38.8	30,014	40.4	67,267	40.4	9,371	23.6	..	..
1937	141,400	32.6	40,823	36.0	62,610	(3)	11,175	19.3	26,792	..
1938	165,201	16.8	57,832	41.7	62,694	0.0	12,386	10.8	32,299	20.5
1939	223,580	35.3	87,530	51.4	93,723	49.4	15,435	24.6	26,892	-16.7
1940	313,456	40.2	134,018	53.1	124,482	32.8	20,285	31.4	34,671	29.0
1941	462,852	47.7	220,722	64.7	172,669	38.6	25,255	24.5	44,206	27.5
1942	585,440	26.5	303,857	37.6	197,179	14.2	31,366	24.2	53,038	20.0
1943	675,233	15.3	344,962	13.6	237,396	20.4	37,519	19.6	55,356	4.4
1944	898,071	33.0	445,617	29.2	254,590	7.3	45,879	22.3	151,985	175.0
1945	1,067,979	19.0	533,262	19.7	256,577	0.8	53,849	17.4	224,291	47.5
1946	1,410,370	32.1	758,466	42.2	253,745	-1.1	86,660	61.0	311,499	38.8
1947	2,008,262	42.4	1,150,538	51.7	274,125	8.0	169,332	95.4	414,267	33.0
1948	2,511,160	25.0	1,473,289	28.1	275,883	0.6	237,638	40.3	524,350	26.6
1949	2,658,749	5.9	1,627,550	10.5	247,103	-10.4	230,210	0.6	544,886	3.9
1950	3,254,082	22.4	2,034,464	24.9	355,456	(4)	251,694	5.2	612,468	12.4
1951	4,100,000	25.9	2,868,000	(4)	230,000	(4)	252,000	0.0	750,000	22.5

(1) Household use plus other requirements by these customers such as irrigation pumping, tractor fuel, flame weeding, chicken brooding and similar uses. Included also is LP-Gas sold by domestic distributors but used for industrial purposes, internal combustion engine fuel and for gas manufacturing purposes. Included also, in 1951 only, is LP-Gas sold direct by producers and marketers solely for fueling internal combustion engines. (See special note.)

(2) For all years prior to 1951, includes LP-Gas sold for fueling internal combustion engines. (See special note.)

(3) Not comparable due to segregation of chemical manufacturing.

(4) Not comparable due to change in method of reporting LP-Gas sold for fueling internal combustion engines.

REMARKS: In this table total sales for all years except 1951, were obtained from U. S. Bureau of Mines reports. Distribution for the years 1931 to 1950, inclusive, was obtained from the same source. All other volumes were estimated by the writers. The total sales volume includes all LP-Gas (propane, butane and propane-butane mixtures) when sold as such. Until 1944 the sale of pentane when sold for any purpose other than motor fuel blending was included. Since then it has been excluded. It does not include butane when blended with heavier petroleum fractions for motor gasoline purposes. Intercompany sales transactions such as purchases of LP-Gases by one company from other companies and resold as LP-Gases have been eliminated in order to avoid duplication of sales figures. The data do not reflect sales of LP-Gases used directly by the producer at the point of production for fuel polymerization, solvent de-waxing, etc. Neither do the figures include sales of hydrocarbons to plants manufacturing synthetic rubber or aviation gasoline or their components.

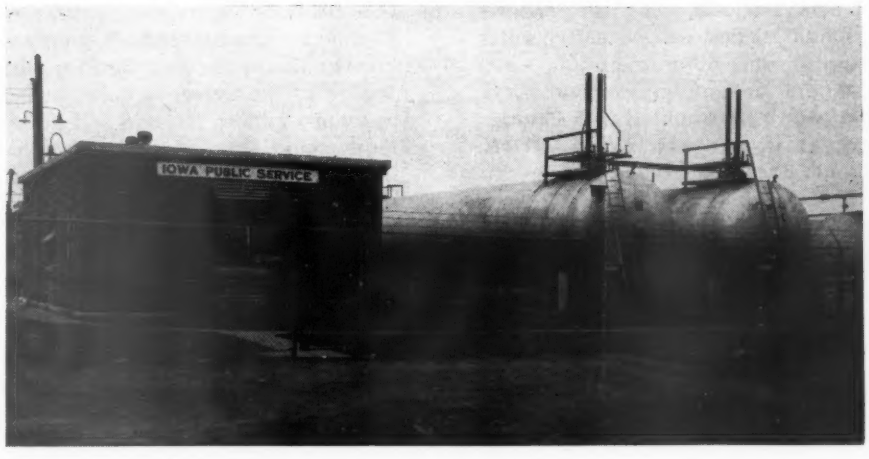
lations. Approximately 260,000 of the automatic gas water heaters manufactured in 1951 were for LP-Gas. The trend toward bulk distribution of LP-Gas continued to gain momentum during the year. Since the major load in bulk distribution is for house heating, it is significant to note that an estimated 19 per cent of the gas-fired floor and wall furnaces produced in 1951 were made for LP-Gas. Appliance sales during 1951 would not, of course, reflect the buying boom of July and August of 1950 caused by the outbreak of hostilities in Korea.

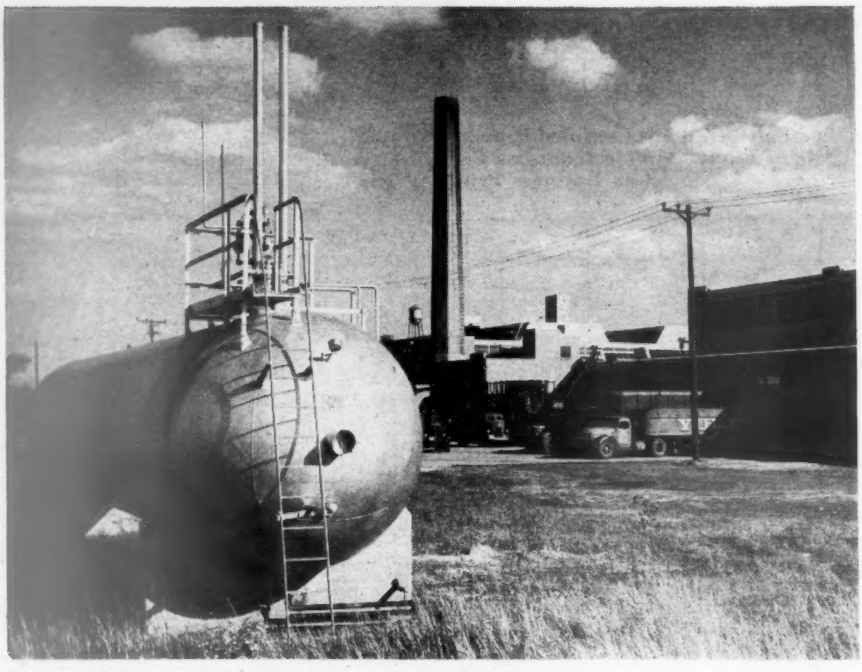
Most LP-Gas distributors entered 1951 with substantial inventories of appliances and equipment. Production and inventories of these items generally remained at high levels during the first half of the year. It was only during the latter months of 1951 that LP-Gas distributors generally began to experience spotty shortages in equipment and appliances and a consequent reduction in their inventories. With the increased demands of the national defense program expected in 1952, it appears inevitable that the availability of these items will be considerably reduced and that new demands for these products may be difficult to satisfy entirely.

At the close of 1951, it is estimated that there were in excess of 8,000,000 LP-Gas installations on farms and in suburban areas. This figure takes into account the LP-Gas installations serving summer homes, trailers, motels and other commercial establishments as well as the growing number of multiple installations on farms. As may be expected, it far exceeds any figures based on single installations at "permanent" residences, which figures obviously do not include the categories listed above. To the millions of families enjoying LP-Gas service, the product has become a familiar household servant dependably providing the convenience and comfort of modern living in farm and suburban homes. Home use of LP-Gas is the backbone of the industry and its widespread acceptance as a basic necessity in the home assures continued sales increases in this market. To serve these millions of installations there now exists an estimated 4500 LP-Gas bulk plants throughout the country. Most of these plants are independently owned and operated by LP-Gas distributors who, in their years of serving the public, have become well recognized for the substantial and responsible part they play in the civic and business affairs of the areas they serve.

The National Committee for LP-Gas Promotion, an industry-sponsored or-

In over 400 communities in this country, utility plants like this distribute LP-Gas alone, or mixed with air, through the gas mains. Utilities also use LP-Gas for peak shaving, standby and gas enrichment purposes.





Typical LP-Gas installation serving an industrial plant. LP-Gas is an ideal industrial fuel.

ganization founded in 1950 to advertise and promote LP-Gas at the retail level, completed its first full year of operation in 1951. Membership in this organization grew rapidly during the year, with some 850 participating companies enrolled at year end. As part of its activity, the National Committee sponsored an intensive study of the industry's unbalanced supply condition brought about by its low summer versus high winter sales demand which is the result of the increased use of LP-Gas for house heating. A well integrated program to combat this problem by promoting adequate storage at the consumer level was developed and initially presented to the industry late in 1951.

Direct motor fuel use of LP-Gas continued its rapid gain in 1951. Promoted and merchandised by LP-Gas distributors, this use of the product is steadily gaining wide acceptance on farms as well as by the bus and truck industries. Actual gallonage of LP-Gas used for internal combustion engines is impossible to accurately estimate. For example, a single bulk tank on a farm may supply LP-Gas as a *heat* fuel (for cooking, heating, chick brooding, water heating, flame weeding, etc.) and as a *power* fuel (for tractor operation, irrigation pumping, and miscellaneous power operations, etc.). The authors feel that this situation, multiplied by thousands of cases, precludes accurate estimating of motor fuel use of LP-Gas. The magnitude and growth rate of direct motor fuel use of LP-Gas is unquestionably tremendous, however. Noteworthy in this field is the excellent promotional work done by LP-Gas distributors who, in most instances, serve this market.

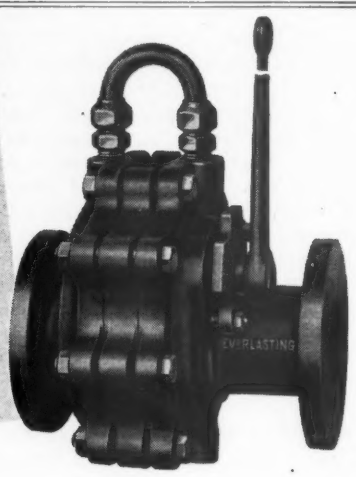
Sale of LP-Gas conversion equipment for farm tractors continued at a high level in 1951. Factory engineered and produced LP-Gas farm tractor models were announced by two additional tractor manufacturers during the year. As previously noted, the LP-Gas load for irrigation pumping reached notable new highs in 1951. Use of the product by trucks, buses, and taxi fleets also showed large gains during the year. Well over 1000 city and inter-city buses using LP-Gas have been put in operation in the last 18 months. Several major manufacturers of heavy duty engines are contemplating the production of factory engineered and produced LP-Gas burning engines. For many such manufacturers, work on this project is well beyond the research and development stage, and road testing is in full swing.

The large potential market for direct motor fuel use of LP-Gas is barely touched as yet. The great interest shown throughout the country by countless companies and individuals interested in fuels and engines, however, indicates a vast future market for direct motor fuel use of the product.

Industrial Use

LP-Gas sales for industrial and miscellaneous purposes totaled an estimated 230,000,000 gal at year end, an increase of 2 per cent over 1950. The last quarter of 1950 brought a definite upsurge in LP-Gas sales to industry as the country's defense program swung into high gear at various manufacturing plants. This activity, plus the effects of decentralization of new defense plants to locations beyond gas mains and a sustained high level of most industrial activity all contributed to higher LP-Gas sales. Counter-balancing effects were caused by the increased availability of natural gas in many industrial areas and by the many temporary plant shutdowns necessitated by a switch from produc-

Valves That Keep VISCOUS MATERIALS Flowing Freely



When you handle coal tar products, asphalts, resins, waxes, molten sulfur, varnish and other materials which congeal at ordinary temperatures, you won't be troubled with clogged valves if you use EVERLASTING Steam Jacketed Valves.

The ample jacket space of these valves surrounds the ports as well as the body . . . provides extensive heating surface and correct temperature to insure fluidity. Besides, the design of the valves is quick acting . . . non-wedging . . . and self-grinding . . . and they have the straight-through flow and lasting tightness that have made EVERLASTING Valves famous for over 40 years. Write for complete information.

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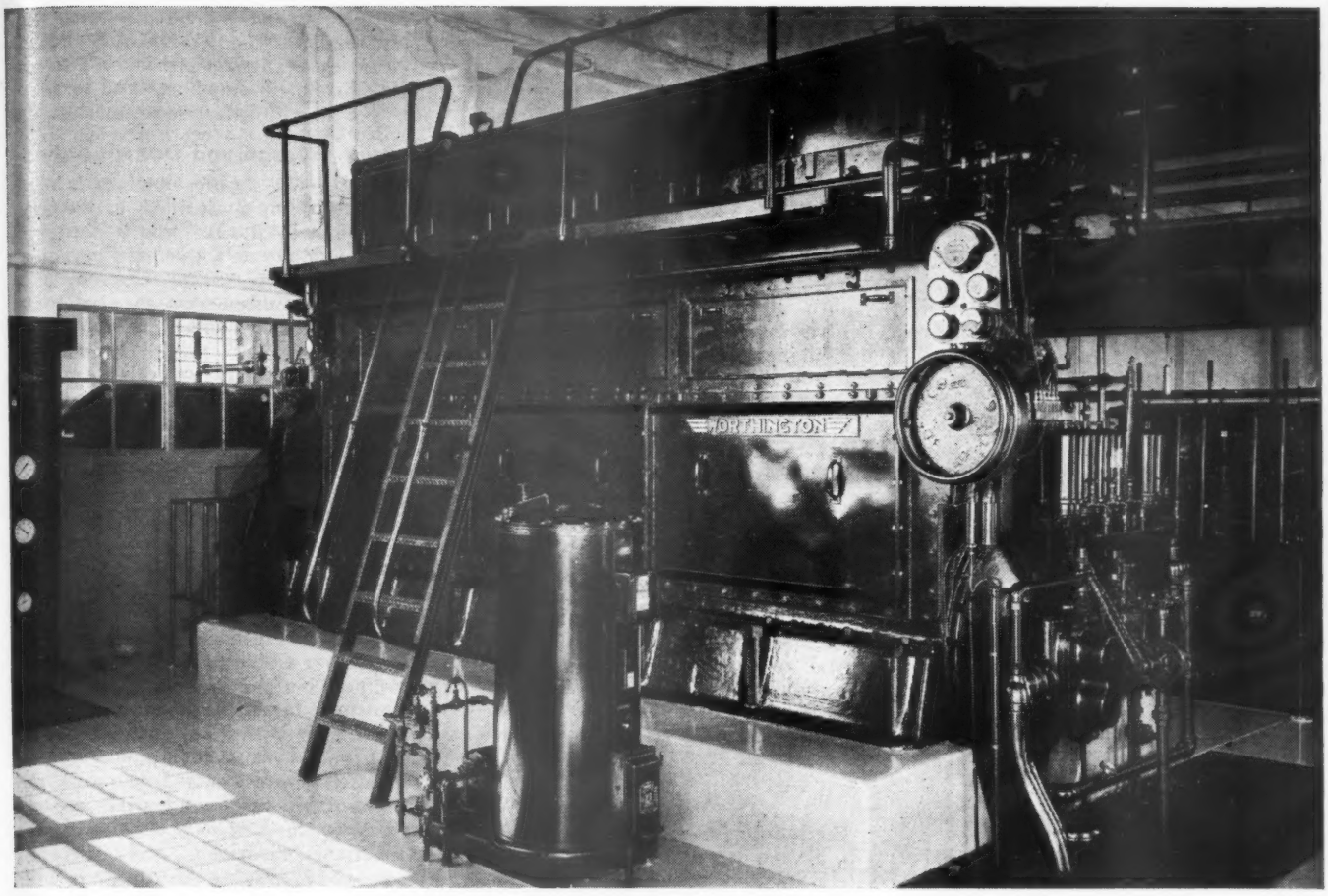

No Standby Needed

Worthington Reliability Saves Thousands of Dollars in Investment Cost

Here's one of twelve Worthington Diesel engines used exclusively on a large oil pipe line running across Texas.

They power the pumps which maintain a constant flow of crude oil from field to refinery.

In none of the pumping stations is there a standby engine. The pipeline company is confident that its Worthington Diesels will *stay on the job.*

Portable pumping units are connected into the line during routine maintenance checks.

Engine fuel is raw crude bled from the line. This is a severe application. But Worthington—one of the first to utilize crude for Diesels—knows how to lick the problem.

For any engine application, call on Worthington—an engine for any fuel: oil (crude or regular), gas or "dual fuel". Worthington's complete line of engines assures you of the most economical operation no matter what fuel you use.

For further information, write Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

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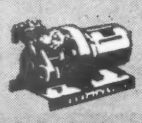
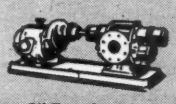
ECONOMICAL CONTINUOUS POWER

Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

WORTHINGTON-BUILT AUXILIARIES

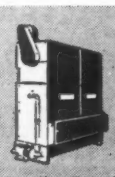


Engine Starting Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps



Evaporative Type Engine Water Coolers

tion of consumer goods to defense items. As defense output rises further gains in LP-Gas use by industry can expected.

Utility Use

Sales of LP-Gas to utilities are estimated at 252,000,000 gal in 1951, the same as 1950. Extension of natural gas lines to new locations and additional supplies of natural gas to areas where it was already available continued during the year. The long term effect of such activities is to increase the potential LP-Gas use by utilities for standby purposes. The short term effect, however, is to reduce actual LP-Gas demand and these short term effects were felt by the LP-Gas industry in 1951. The extreme shortage of LP-Gas transportation during the early months of 1951 also reduced LP-Gas sales to utilities in that period, as the industry was unable to supply the spot demand for standby purposes. This tight winter situation emphasized the important point that, for standby use, utilities must have ample LP-Gas storage facilities—and the storage must be filled during the spring and summer months. As the long term effects of increased demand on natural gas systems are felt, increased sales of LP-Gas to utilities for augmenting supply can be expected.

Chemical Manufacture

The sale of LP-Gas as a raw material for the manufacture of chemicals and of chemical intermediates again set an all-time high during 1951. Total sales for this use are estimated to be 750,000,000 gal, an increase of 22.5 per cent over 1950. If the large volumes of LP-Gas used in the manufacture of components of synthetic rubber and aviation gasoline were to be included, the total would be considerably higher. It is estimated that 344,000,000 gal of LP-Gas were used during 1951 by the synthetic rubber industry alone. This compares with 228,485,000 gal in 1950.

The petrochemical industry grew very rapidly during 1951, especially in the Gulf Coast area, where it is estimated that plant projects announced, started or completed, involved the expenditure of more than $250,000,000. Basic raw materials for these plants include LP-Gas, oil and natural gas. These new plants insure an increasing demand for LP-Gas by the chemical industry.

The more important chemicals manufactured from LP-Gas hydrocarbons include alcohols, organic acids, acetates, anti-oxidants, detergents, plastics, resins, glycols, and special solvents. Cracking or dehydrogenation is usually employed to form ethylene and/or propylene, following which synthesis can proceed along numerous routes to the above mentioned commercial grades of petrochemicals.

Safety

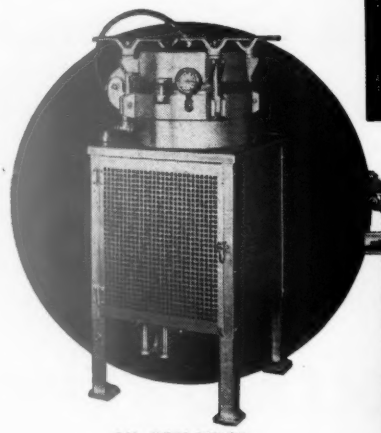
The industry is doing a commendable job developing and practicing sound safety standards. Through its national Liquefied Petroleum Gas Association it works closely with NBFU and NFPA collectively, and individually with the state regulatory bodies. NFPA Standard No. 58 was again revised in 1951 to reflect current developments and to keep up to date with safety requirements.

Supply, Storage and Transportation

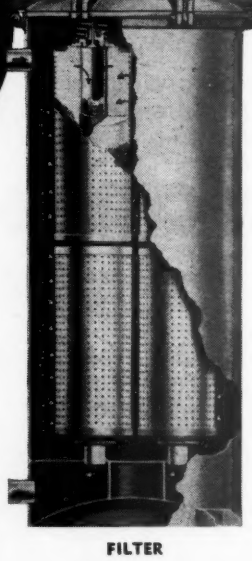
The present supply situation is very tight and many indications at the moment point to another winter shortage. The Committee on Liquefied Petroleum Gas Availability, Transportation, and Material Requirements appointed by the National Petroleum Council in May, 1951, has reported maximum monthly production capacity up 15.7 per cent over last year. The increased demand of 25.9 per cent in 1951 over 1950 indicates a relatively increasing consumption of LP-Gas during the off-peak demand months.

There are several reasons for the present tight supply situation. These include the delay some major producing sources experience in "getting on stream", and disappointing production volumes from some that did come on stream. Plants that recover a high per cent of the available propane require much larger investment in facilities and equipment and have higher operating costs than the usual type of plant. Such plants are not attractive to investors and operators unless favorable year-round prices are received for the LP-Gas.

At many refineries C_3 and C_4 hydrocarbons in increasing quantities are now being converted to motor and aviation gasoline by polymerization and alkyla-



OIL RECLAIMER



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tion processes that yield the refiner better return than if sold for LP-Gas. The change from 13.5 to 15 lb R.V.P. motor gasoline during the winter months in northern areas may require as much as 420,000,000 gal more of butane than heretofore.

All of these, coupled with the great demand for LP-Gas for house heating and generally inadequate consumer storage for this demand has resulted in the present (and future) critical supply balance during the winter months.

Storage, historically, has always been a major industry problem because of the relatively high cost of pressure-type steel storage tanks. Many producers now have programs under way, however, for adding to their primary storage capacity. The types that presently offer the best solution are the underground storage caverns. These may be washed in salt beds or domes or may be mined in suitable limestone or shale formations and have capacities up to 100,000 bbl (4,200,000 gal) or more. Many of these were not completed in time to fill them during the summer months so their effect will be more fully realized in the winter of 1952-1953.

The volume movements of LP-Gas from large producing areas has resulted in the adoption of transportation methods used to move large volumes of other petroleum products. Another barge has been constructed for coastwise hauling and another terminal constructed during the year. A pipe line for the movement of propane from the Texas Panhandle to the Chicago area is under construction. Pipe line movement of LP-Gas has proved to be practical and economical with several lines now in operation.

As it is estimated that 50 per cent of the LP-Gas is transported by tank car, a review of the tank car situation is important. The Defense Transportation Administration census of tank cars as of January 1, 1951, revealed that there were 10,302 pressure cars in liquefied petroleum gas service.

As of October 1, 1951, 1270 cars had been added to the fleet during the year, making a total of 11,572 LP-Gas tank cars in service. It is further estimated that by the end of the year 1071 additional LP-Gas cars will be completed and placed in service. In addition to these cars a large number have been constructed for dual service (anhydrous ammonia-liquefied petroleum gas). The drastic effects of not keeping the cars rolling was clearly demonstrated during the railroad strike of last winter.

The year's progress indicates a continuing increased demand for LP-Gas comparable to that experienced in the past. There are indications that production will have difficulty in keeping pace with the demand during peak winter months. This unbalanced supply versus demand condition is influencing larger storage at all stages of the distribution channels. The results of this influence can make it possible for the industry to balance its demands and supply in a reasonable period of time. * * *

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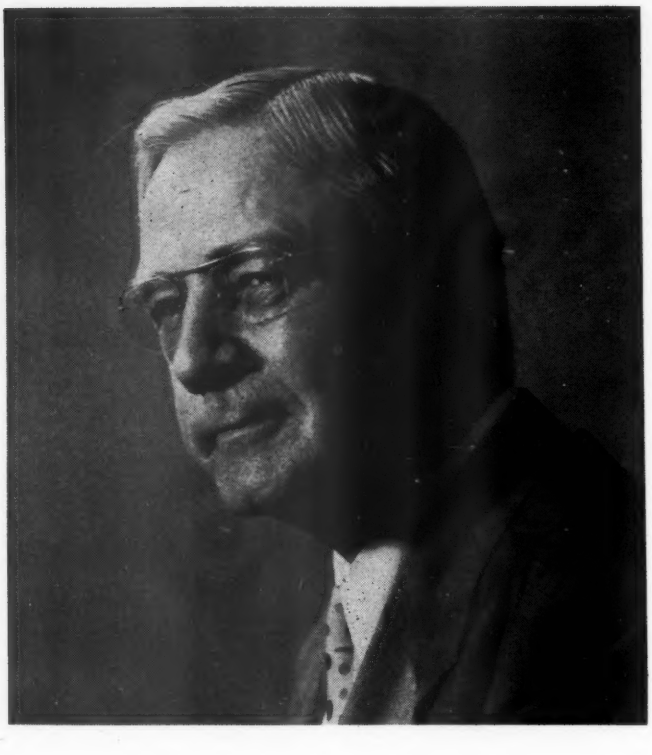


K. C. HEALD
Vice President
Gulf Oil Corporation

KENNETH CONRAD HEALD is one of the outstanding geologists of our time. Vice president of Gulf Oil Corporation, he has been with that company for 27 years. He has been guest lecturer at the University of Pittsburgh since 1926, and in recognition of his contributions to petroleum geology the university conferred the honorary doctor of science degree on him in 1945.

After graduating from Colorado College in 1912, Heald joined the Yale Peruvian Expedition, later returning to the United States, where he took graduate work at Yale University from 1912 to 1914. Upon leaving Yale, he accepted an appointment with the U. S. Geological Survey, and after 5 years was appointed chief of the oil and gas section in 1919. He returned to Yale as associate professor of petroleum geology in 1924.

Heald has been associate editor of the American Association of Petroleum Geologists' Bulletin for the last 31 years, 1921-52. He has served as member of or chairman of many important association committees, and is former AAPG representative on the National Research Council, serving in that position for four years.

He was chairman of the ways and means committee, 1920; program and editorial, 1921; central committee, 1922; general committee, 1923-26; business committee, 1927-28; research committee, 1928-38, 1946-48; committee on college curricula in geology, 1943, and national service committee, 1943-45.

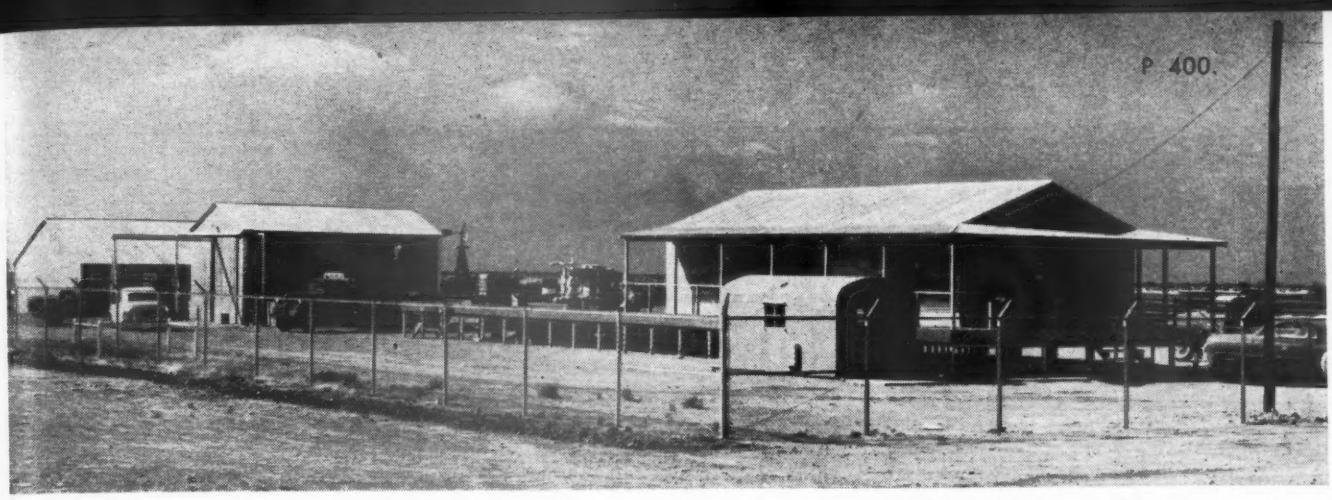
In World War I Heald was a captain in the Engineering Corps, and afterwards served as a lecturer on geology at the University of Chicago and at John Hopkins University. In 1925 he joined Gulf Oil Corporation, in the position of staff geologist.

As early as 1927, Heald was publicly recognized as ranking among the 1000 leading scientists in the U. S., as recorded in the American Men of Science. During 1924-31, he had actively served as a member of the executive committee on division of geology and geography of the national research council. He has had major scientific contributions published in the AAPG bulletin. Among these were:

"Oil-bearing Horizons of Wyoming" (1921); "National Research Council and Oil Geology" (1923); "Oil Geology and Science" (1924); "Research and American Association of Petroleum Geologists" (1928); "Subsurface Temperature Gradients" "Problems of Petroleum Geology" (1934); and "Highlights of Domestic Developments in 1946" (1947).

As further recognition of his outstanding contributions to the field of petroleum geology, Heald will be awarded the Sidney Powers Memorial Medal of the AAPG at the 37th annual meeting next month. Named in honor of the late Sidney Powers of Tulsa, Oklahoma, 14th president of the AAPG, the medal is being awarded to Heald, charter member, in recognition to his long and outstanding service and contributions in petroleum geology, and for his leadership in research bearing on the important problems of the origin of oil. Only five other petroleum geologists have received the Sidney Powers Memorial Medal: Wallace E. Pratt, 1945; Alexander Deussen, 1947; A. I. Levorsen, 1948; E. DeGolyer, 1950, and Max Steineke, 1951.

The outstanding leadership of Heald as a scientist has been recognized by other scientific organizations. Dr. Heald is a Fellow of the American Association for the Advancement of Science, The Geological Society of America, and the Royal Geographical Society; he is also a member of the American Petroleum Institute, the Society of Economic Geologists, the American Institute of Mining and Metallurgical Engineers, the Army Ordnance Association, and the American Geophysical Union.



Wilshire Oil Company field office and yard.

Preliminary Geological and Engineering Data Wilshire-Ellenburger Field, Southwest Texas

MYLES A. COLLIGAN AND O. H. BERRY, JR.

DISCOVERY of the Wilshire-Ellenburger field (Fig. 1) in April, 1951, confirmed the potential magnitude of deep oil productive possibilities in the relatively unexplored southern Midland, Texas, basin as suggested by the Benedum, Pegasus, and Sweetie Peck fields.

Visualization of subsidiary folding paralleling the Central Basin Platform aided by seismic data offered inducement for the drilling of the first Ellenburger test in the area, Wilshire Oil Company's McElroy Ranch Company No. 23-148 well, in 1948. Although this venture proved barren in the Ellenburger, subsurface data and subsequent seismic activity warranted the drilling of the discovery well, Sinclair Oil and Gas Company's McElroy No. 1.

The ensuing rapid development of 6 wells during a 7-month period and the tempo of current development (16 rigs) is affording geological and engineering data to supplement sparse knowledge of deep structures in the Midland Basin.

The wells drilled to date, within the field proper, have found general uniformity of the formations, however, some minor changes have been observed and their occurrence will be discussed. Some of the wells that have been drilled off the present subsurface structure encountered pronounced changes in the thickness and physical characteristics of the formations. These formational changes have caused much speculation concerning the possibilities of additional pays fringing the main structure.

The Wilshire Oil Company No. 24-129 McElroy well, a typical field well, penetrated 12,306 ft of sediments. The deepest penetration to date is the Sinclair No. 2 McElroy well which penetrated 12,575 ft of sediments. The formations in these two wells, as in all wells throughout the field, are recognized primarily from lithologic characteristics, and confirmed, in many cases throughout the Leonard and Wolfcamp series and Pennsylvanian formations, by diagnostic fusulinids.

The shallow Trinity sandstone (Base of Cretaceous) is not an aquifer in this area; however, casing is run to 200 ft to protect any stray water sand.

Minimum attention is given to the red beds of the Triassic, and the salt and red bed section of the Guadalupe series of the Upper Permian age.

Attention is first focused on the sandy limestone of the Greyburg formation of the Guadalupe series, primarily because this sandy limestone offers a solid seat for the cementing of the intermediate casing. It seems to be the general practice throughout the field, however, to set the intermediate string in the San Andres limestone. This is the first massive light colored limestone that carries oolites and is capped by a thin layer of dense brown dolomite. Oil shows have been encountered in the San Andres and very good porosity is associated with the oolitic section. The Standard of Texas No. 11-119 McElroy test on this zone of staining and porosity yielded 35 ft of gas cut mud. Zones of minor staining

EXCLUSIVE

The Authors

Myles A. Colligan was graduated from the University of California at Los Angeles in 1940 with a BA degree in geology. He took graduate work in geology in 1941, and during the following four years he worked as an engineer in the aircraft industry. He joined the Wilshire Oil Company, Inc., California division, as a geologist in 1945, and in 1950 transferred to the Texas division where he is presently serving as district geologist.

O. H. Berry, Jr., was graduated from the Agricultural and Mechanical College of Texas in 1947 with a BS in petroleum engineering following a three year interruption of his education while serving as an engineering officer in the USNR. He commenced work as a petroleum engineer for Standard Oil Company of Texas upon graduation and resigned as division petroleum engineer from this company early in 1951. He joined Wilshire Oil as district petroleum engineer in April, 1951.

Myles A. Colligan O. H. Berry, Jr.

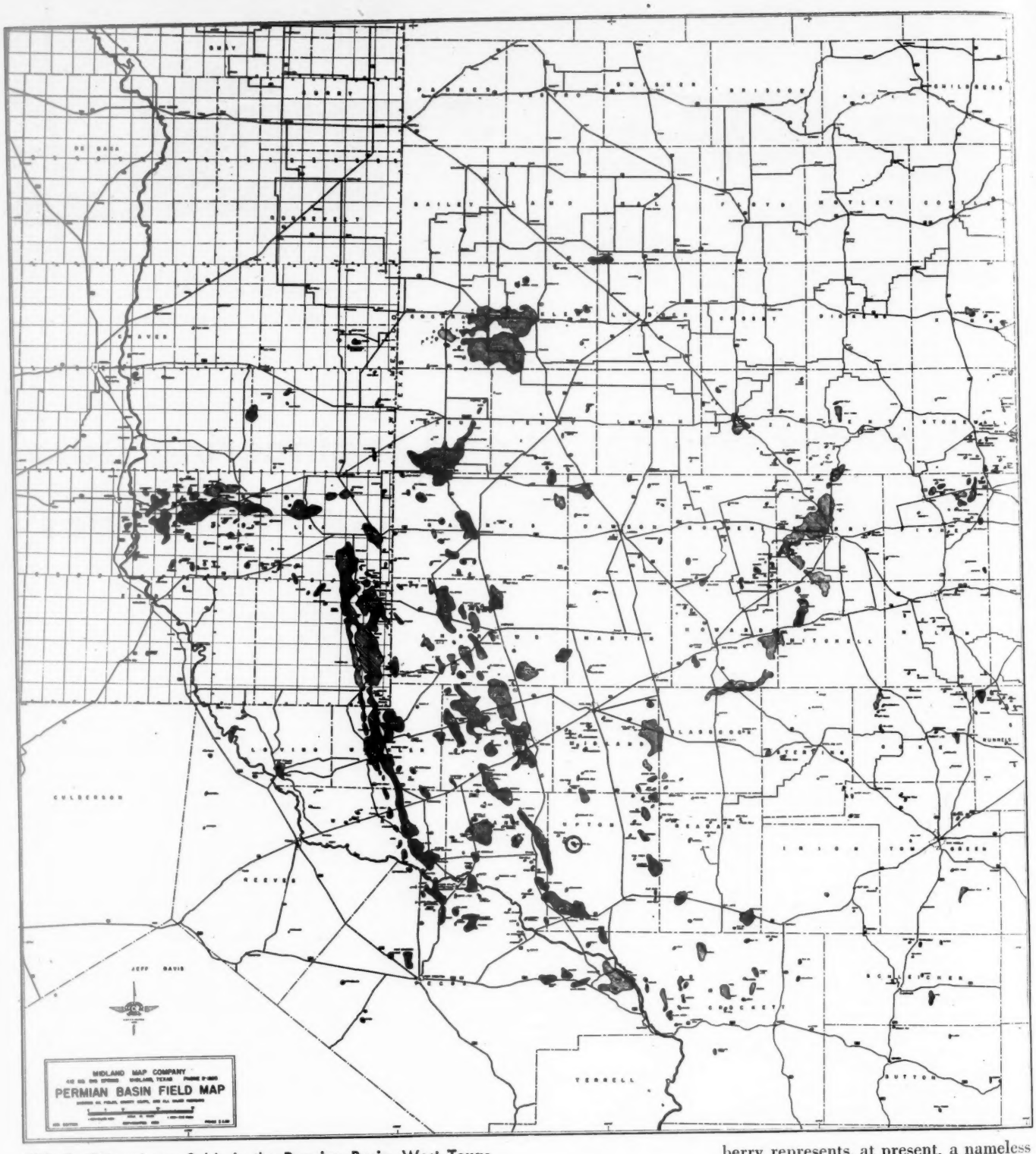


FIG. 1. Oil and gas fields in the Permian Basin, West Texas.

and porosity, further into the San Andres, have been tested with no shows of oil or gas in the recovered mud.

Lying below the San Andres formation and at the base of the Guadalupe series is the Glorieta sandstone. Very few shows have been observed within its sandy limestone, sandstone, and limestone members. In one well, a sandstone interval in its upper portion was tested which showed no oil or gas in the recovered mud. Fragments of fusulinids are often found in the lower 100 ft.

The top of the Clear Fork group lying at the top of the Leonard series is determined by the presence of brown, angular siltstone immediately underlying a pale brown limestone member of the lower Glorieta. The Clear Fork "group" from well to well within the field, often varies in the amount of sandstone, while the limestone and shale relationship tends to be more constant. The portion of the Leonard that occurs in between the very indefinite base of the Clear Fork and the top of the Spraberry represents, at present, a nameless member and is composed chiefly of shale and limestone. Scattered fusulinids, often fragmentary, are found in this interval and they are diagnostic only to the extent of denoting a Leonard age. A drill stem test was conducted on a sandy limestone member in this lower interval and a slight amount of gas cut mud was recovered.

The Spraberry formation is poorly developed, and is represented usually by 20 to 40 ft of very fine, brown, tight sandstone. Its determination as Spraberry is made on the basis that it is the lowest sandstone in the Leonard series, lying above the Wolfcamp. In several

wells, Leonard fusulinids were found in the limestone immediately overlying the Spraberry sandstone. No shows have been observed in the sand, and to date, no drill stem tests have been conducted.

The Wolfcamp series is represented by a fairly thick interval of interbedded shales and limestones. Fragments of milky chert occur in the limestone throughout its lower portion. The Dean sandstone of the Wolfcamp series lies in the upper portion, and usually consists of 150 ft ± of grayish brown, very fine angular sandstones containing numerous shale strata and scattered streaks of limestone. Some minor shows have been observed but, to date, no drill stem tests have been conducted. Wolfcamp fusulinids are found in the limestone streaks within the sandstone, and its position as the first sandstone encountered below the top of the Wolfcamp places it in the stratigraphic position of the Dean sandstone of other areas.

The Wolfcamp, encountered in the field wells, contains diagnostic fusulinids especially numerous in its lower part. Some porosity is observed in the lower portion and in one field well a test was run on a limestone member in the lower 300 ft, which yielded no shows of oil or gas.

The Wolfcamp series lying at the basal part of the Permian section, thickens in both a westerly and southeasterly direction. On structure, the Wolfcamp has an average thickness of 1744 ft, whereas, off structure and to the west in the Wilshire Oil Company No. 23-148 McElroy, Wolfcamp producing well, the formation is 2532 ft thick. It should be noted, that in this well, the additional thickness occurring in the Lower Wolfcamp section contains numerous Wolfcamp fusulinids that appear to be in correct age sequence with the overlying Wolfcamp.

Towards the southeast, the Wolfcamp again thickens off structure, and is 2230 ft in the Greenbrier No. 1 Windham well. The Wolfcamp sections in the two wells are correlative to the extent of their presence.

The Wolfcamp series flowed oil on a test in the Greenbrier well and is producing, and has been producing for over two (2) years, in Wilshire Oil Company No. 23-148 McElroy well. These two wells, with their thickened sections give rise to interesting speculations on the areal extent of the Wolfcamp and the relationship of its thickened section with the flanks of the Wilshire-Ellenburger structure.

Normally on structure, the Lower Strawn "limestone formation" of Pennsylvanian age is capped by a green shale containing streaks of light gray microcrystalline limestone and carrying Lower Strawn fusulinids. In the Wilshire Oil Company No. 23-148 McElroy Wolfcamp well, however, the lithologic unit occupying that same position above the Lower Strawn "limestone formation" is a dark gray shale. Detail studies of samples show that immediately overlying the green shale in the Sinclair No. 2, 4, and 6 McElroy wells, and Wilshire Oil No. 13-118 Windham, 20 to 60 ft of very dense white to yellowish brown, very fine crystalline limestone is encountered. This unit contains Upper Lower Strawn ("Upper Cherokee")* fusulinids and is readily distinguished from the fauna and lithology of the overlying Wolfcamp. This limestone unit thins rapidly westward and is not present in the Wilshire Oil No. 13, 23, or 24-129 McElroy wells. It is present to the east, however, reaching a thickness of 60 ft in Wilshire Oil No. 13-118 Windham well and 60 ft in Sinclair No. 6 McElroy well. This unit is probably present, though not necessarily detected as yet, in wells lying northeast, east, and southeast of the structurally high portion of the field.

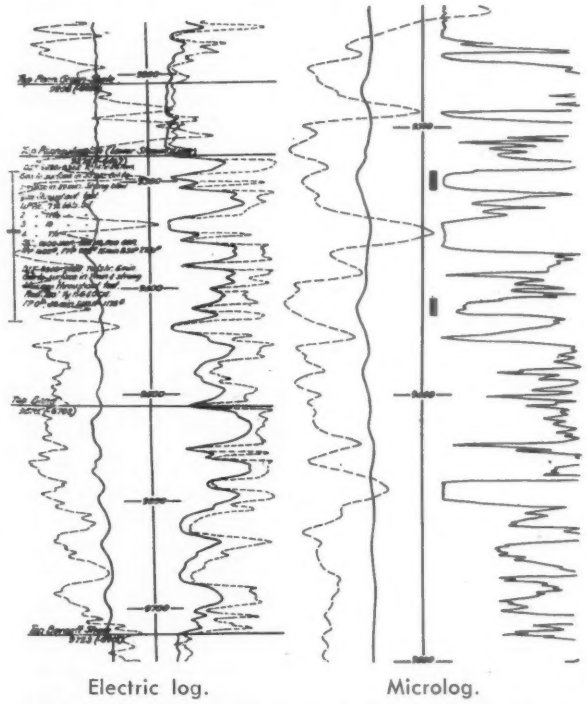
*H. L. Williams, Paleontological Laboratories, Midland, Texas.

The Lower Strawn limestone formation ("Lower Cherokee"), which underlies the green shale, is light grayish brown, finely crystalline with characteristic bluish gray spotted chert. Porosity usually ranges from fair to good throughout most of the formation. Very little porosity was observed in the Lower Strawn limestone in wells situated on the west and southwest flanks of the structure, however.

The production from the Lower Strawn has been very erratic. Sixteen wells have penetrated the Pennsylvanian, 12 of which had drillstem tests in the Lower Strawn limestone. Four flowed oil at the rate of 56 bbl per day to 480 bbl per day, and ranging from 46.3 to 56.0 gravity, and a gas-oil ratio of 10,150:1 to 18,500:1. Two wells flowed gas and recovered free oil, and 3 wells flowed gas and recovered oil and gas cut mud in varying quantities, and 3 wells recovered varying amounts of oil and gas cut mud.

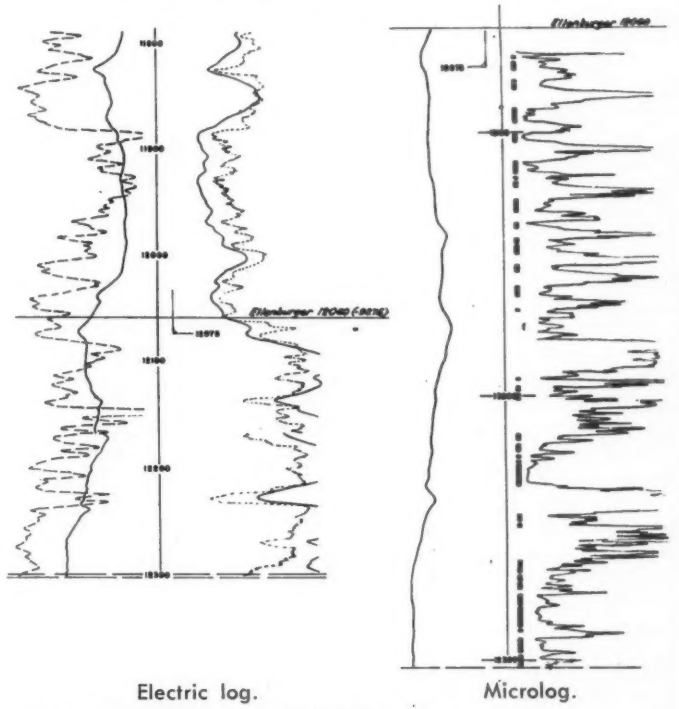
All the tests were taken within the top 100 ft of the Lower Strawn limestone (Fig. 2). The average penetration to the top of the tested interval is 34 ft. The present development of the

FIG. 2. Wilshire McElroy No. 23-129.



Electric log. Microlog.

FIG. 3. Wilshire McElroy No. 24-129.



Electric log. Microlog.

Note: Electric log shows gamma ray in long dashes, normal curve in solid line, and 32-in. L S lateral in short dashes.

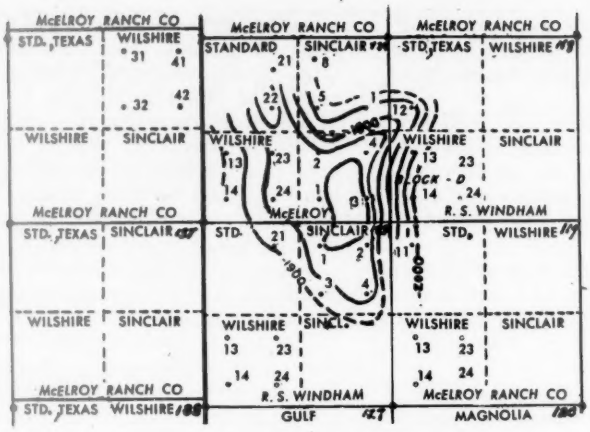


FIG. 4. SAN ANDRES

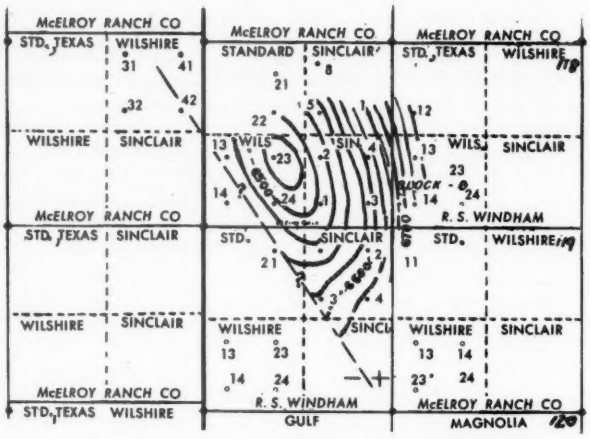


FIG. 5. LOWER STRAWN LIMESTONE

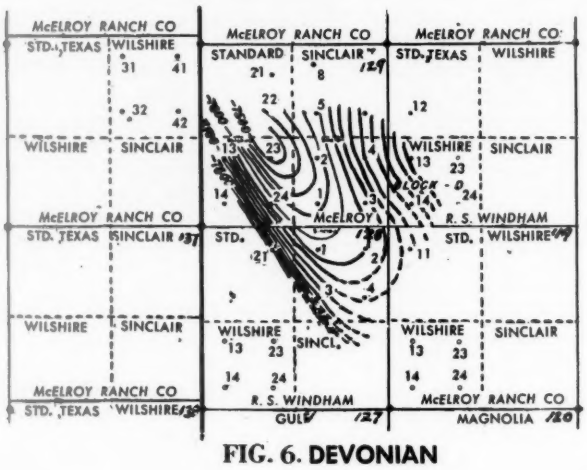


FIG. 6. DEVONIAN

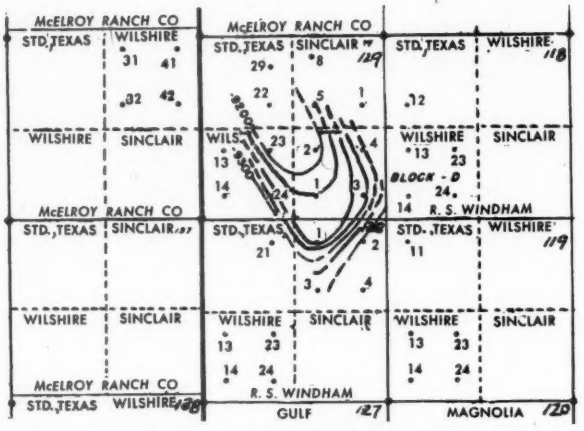


FIG. 7. ELLENBURGER

field indicates that the production in the Lower Strawn appears to be favoring the crest of the structure and the more gently dipping east flank. One structurally high well flowed gas only, however, while offsets to the east, south, and west flowed oil. The north offset was not tested.

At the time of this writing, the Pennsylvanian Lower Strawn limestone is not being produced.

The underlying Atoka series is comprised of limestone and shale, the limestone containing milky chert and occasionally glauconite. Diagnostic fusulinids are found within the Atoka. The base of the series is often characterized by a sandstone stringer, 5 to 20 ft thick immediately overlying the Barnett shale of the Mississippian age.

The Barnett shale is usually about 440 ft thick, and is a dark gray splintery shale. Occasionally it has streaks of brownish gray limestone, or a streak of soft greenish gray shale, or sometimes, a streak of gray siltstone.

Lying at the base of the Barnett and above the Woodford, is usually 20 ft of grayish, brown, argillaceous limestone that is characterized by glauconite at the base. The term "Mississippian" limestone equivalent is commonly used for this member.

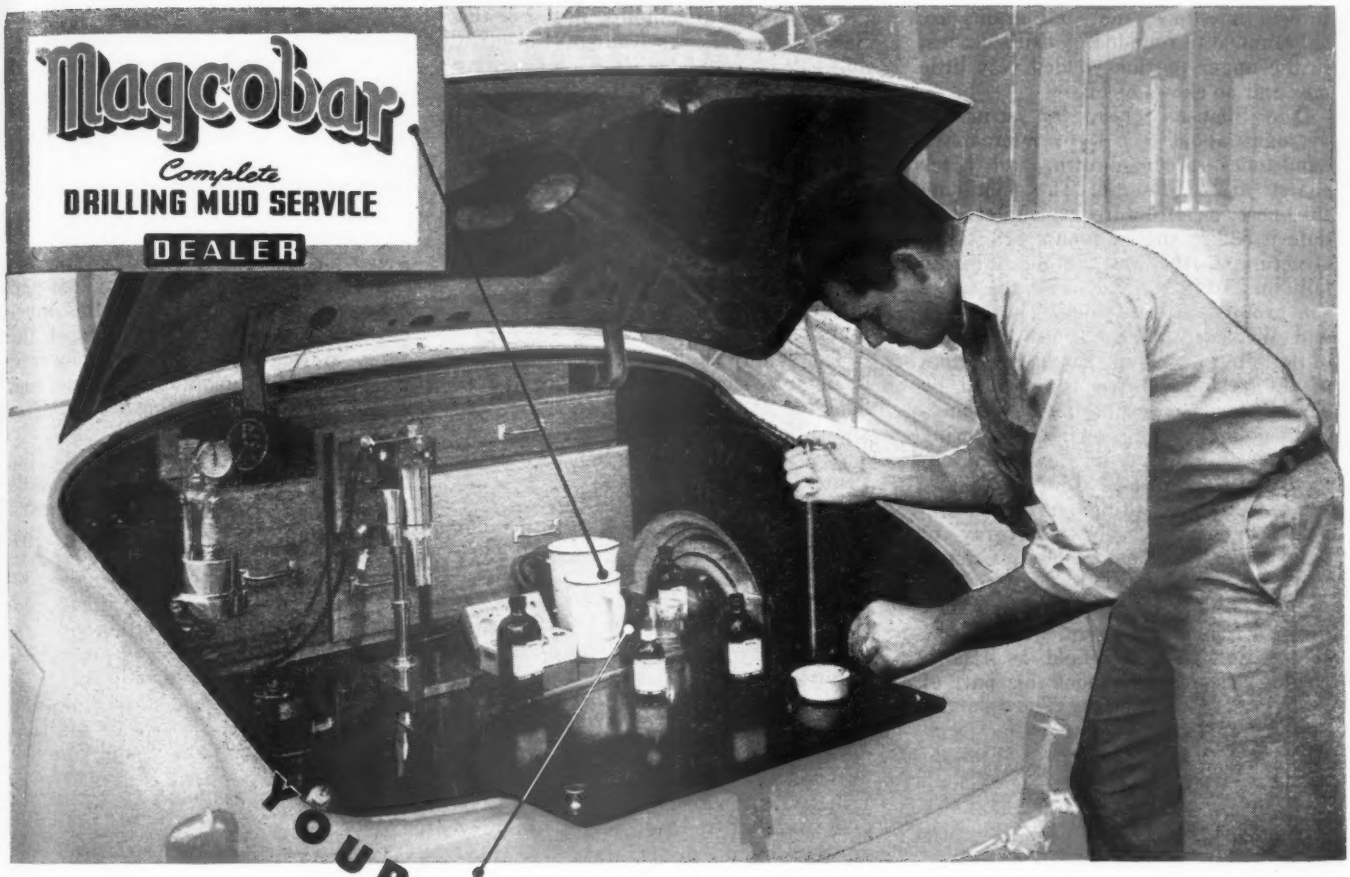
The Woodford shale is usually about 130 ft thick, and is a dark dusky brown non-calcareous shale that on rare occasions carries spores ranging from black to amber in its lower section.

The Devonian is a very characteristic formation, and is readily recognized on the electric log by its pronounced resistivity curve and by lithology from its brown color, finely crystalline texture and the cherty siliceous nature of the limestone. Bluish gray to pale brown spotted chert, as well as thin laminae of gray shale are also present in the upper portion. Glauconite is common in the upper half. The limestone remains siliceous throughout. The chert varies in amount, however, and often in the middle of the formation, little chert is found. A black calcareous shale bed lies at the base of the Devonian. Gas shows of varying degrees are common throughout the formation. One test 20 ft below the top recovered only gas cut mud with no shows of oil. Other tests lower in the section have had gas flowing to the surface. A siliceous cherty limestone was cored in the middle part of the Devonian section in the Wilshire Oil No. 24-129 McElroy well. The lime contained numerous fine fractures that bled oil and when broken open yielded a gas odor. A test, conducted in this interval, flowed gas at the rate of 15,000 cu ft per day.

Underlying the Devonian is a pale green shale of Middle Silurian age. Usually underlying the shale and included in the same unit, is a light to olive gray, very fine crystalline limestone. The limestone varies in proportion to the amount of shale, and is often oolitic and occasionally carries ostracod fragments.

The underlying Fusselman limestone, also Middle Silurian in age, is readily distinguished, on lithology, from the overlying Middle Silurian shale and limestone. The Fusselman is a coarsely crystalline white limestone with scattered pink crystals, traces of bluish white chert, and glauconite. Oolites are characteristically developed in the basal units. The Fusselman, in many areas of West Texas, is an important producer of oil. Very often in certain areas extremely porous conditions have been encountered with associated loss of circulation. In the Wilshire-Ellenburger field, however, the Fusselman has moderate porosity in its upper interval; gas is observed and drilling time is increased; a trace of fluoresence is noted. A drill stem test, of the interval, produced a strong flow of gas to the surface and recovered 280 ft of heavily gas cut mud. The lower part of the Fusselman is less porous. A test of this portion, and including the top few feet of the equally non-porous Montoya formation, recovered 140 ft of slightly gas cut mud.

The underlying Montoya is about 110 ft thick. It is distinguished from the overlying Fusselman by a finely crystalline brown limestone. The limestone often carries brownish black speckles and blue to brown spotted chert. The basal portions contains a 10 ft arenaceous



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brown limestone; the sand grains are subrounded to rounded. A drillstem test in the upper portion yielded very little gas, and no shows of oil.

The Simpson group, on structure, averages about 577 ft of intercalated sandstones, green, brown, and black shales and limestone. The minimum thickness, on structure, encountered to date is 532 ft, the maximum 618 ft. Off structure, to the west, in the Wilshire Oil No. 23-148 McElroy well, the Simpson group is 700 ft thick. The McKee and Waddell sandstones are members of the Simpson group. The basal portion of the group is often represented by slightly arenaceous limestone or arenaceous dolomite, or sometimes varying amounts of both, grading downward into the definite arenaceous "Joins" dolomite.

The "Joins", resting on top of the Ellenburger, is a brownish gray to brown colored dolomite, finely crystalline and containing numerous fine to medium grained rounded sand grains.

The Ellenburger group, which is the main objective in this field, as it is in so many fields throughout this part of West Texas, is a dolomite. The dolomite is dense, pale brown, very finely crystalline, even textured, and carrying micro streaks of white dolomite.

Detail work on the microlog (Fig. 3) and expanded gamma ray curves suggest the presence of several irregular zones of porosity. The question arises, as to the probability of intercommunication existing between the porous zones, the interpretation of which can be an important factor in planning the completion methods to be used. The pore space in these zones ranges from extreme vuggularity to countless divergent fractures, hairlike to coarse in texture. Occasionally, minor amounts of secondary mineralization is present in some of the fractures. The vugs carry abundant small rhombs of dolomite. The open fractures, even though hairlike in size, along with the more coarse fractures and vugs, form the oil reservoir. The dolomite matrix is extremely dense with very low values of porosity and permeabilities. Whether or not the dense matrix acts as a reservoir, and to what degree, is a highly debatable question.

Structure

The general structure of the Wilshire-Ellenburger field, at the time of this writing, appears to be in harmony with the regional geology of Upton and southwestern Midland and Reagan counties.

There appears to be general alignment of the structural axis of the Wilshire-Ellenburger field with the axis of the Benedum structure as well as general alignment with the eastern edge of the Central Platform, south and east of the town of McCamey.

The field is situated just east of the axis of the Midland Basin, the deepest part of the basin probably lying west of the Wilshire Oil No. 23-148 McElroy, Wolfcamp producing well, and east of the Gulf Oil No. 1-H McElroy, Pennsylvanian producing well.

The structural contours on top of the San Andres, Pennsylvanian, Devonian and Ellenburger (Figs. 4-7) formations suggest a general vertical alignment of the axes, with an average bearing of N48°W. The NW-SE trend of the structure, however, appears to be deflected slightly towards the North in the vicinity of the N½ of Section 129. This deflection is more pronounced on the San Andres because at present there is more control on that horizon. This anomaly, in varying degrees, is noticed in the contours on the lower horizons.

The southwest flank of the structure is notably steeper than the northeast flank on the Pennsylvanian, Devonian, and Ellenburger horizons. This steepness is shown best by the lowness of the Pennsylvanian and Devonian horizons encountered in the Standard of Texas No. 21-128 Windham well with respect to the wells to the north. Also, the lowness of the Pennsylvanian horizon in the Wilshire Oil No. 13-129 McElroy well with respect to the wells to the east. On the relatively shallow San Andres horizon the northeast flank is slightly steeper than the southwest flank.

The structural position of the above wells, together with the asymmetry of the structure, suggests the possibility of a fault lying along and probably running parallel to the steeply dipping southwest flank of the structure. It is quite possible that the Standard of Texas No. 21-128 Windham well penetrated this fault close to the base of, or immediately underlying the Wolfcamp formation, thus accounting for the lowness of the Pennsylvanian horizon. Crooked hole trouble from this point on down may be attributed, to a large extent to the presence of this fault.

The interpretation of the vertical alignment of the axes, between the deepest and shallowest horizons, indicates a very steeply dipping normal fault. This postulated fault, running northwesterly, with its northeast side upthrown, may account in part for the difference in elevation on the lower horizons between the field proper and the Wilshire Oil Company No. 23-148 McElroy, Wolfcamp producing well.

At the present time the Sinclair No. 2 McElroy well is structurally the highest well in the field on top of the Ellenburger, having encountered the top at 11,961 ft (-9178). This well penetrated the Ellenburger 614 ft, the deepest penetration to date, and bottomed in an unproductive dolomite that gave indications of containing water at a depth of 12,502 ft (-9719).

Of the 614 ft of Ellenburger penetrated, in the above well, 541 ft represents the total pay interval. Of this interval, the lower 144 ft looks less permeable on the microlog than the upper part of the pay. Examination of the cores in this lower interval, however, showed fair to good oil staining and fractured porosity ranging from fair to good.

The structure is still open to the northwest and, consequently, wells drilled along that trend will encounter greater closure. At the time of this writing the Standard of Texas well in Section 35, that was later taken over by Wilshire Oil Company and abandoned, due to mechanical difficulties, may be well situated for commercial production from the Ellenburger group.

The stratigraphic and structural problems of this portion of the Midland Basin are both numerous and complex

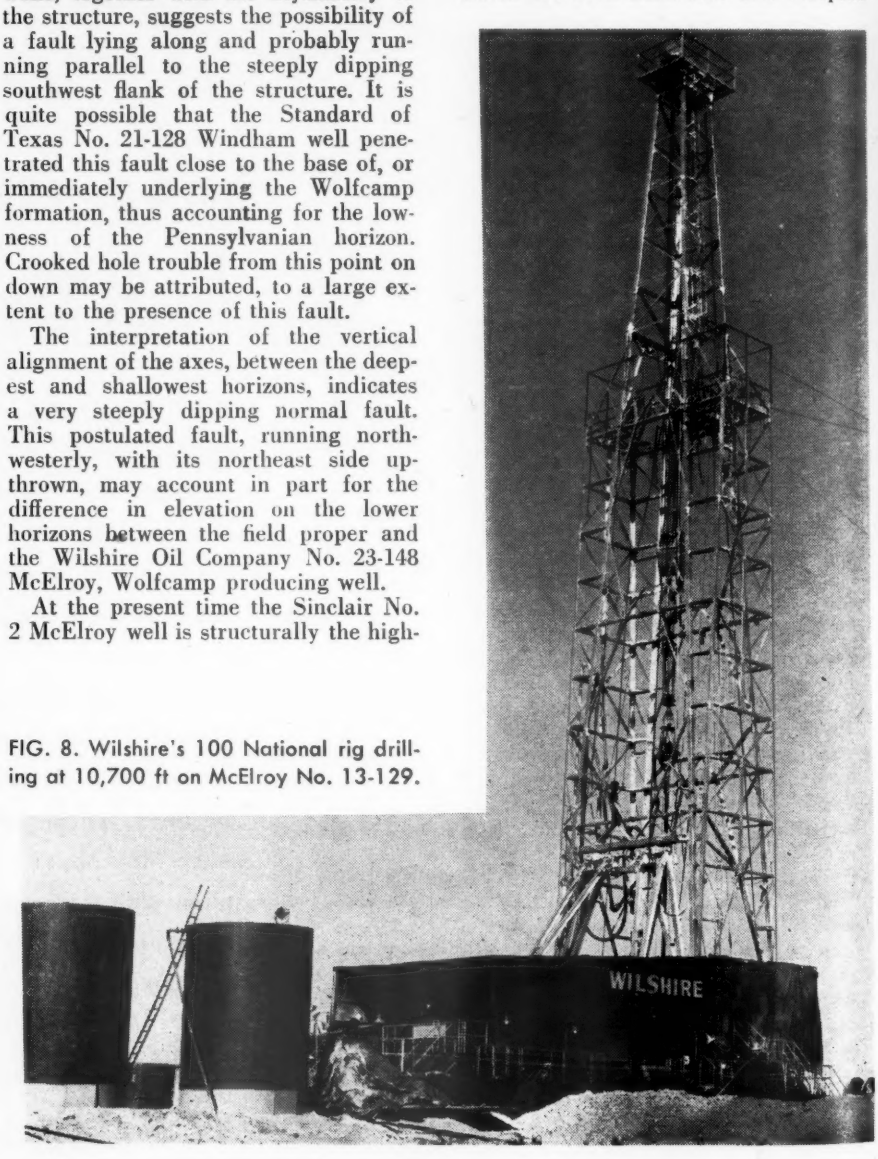

FIG. 8. Wilshire's 100 National rig drilling at 10,700 ft on McElroy No. 13-129.

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in nature. There have been many interpretations to explain the occurrence of the apparently isolated deep structures that occur so widely separated throughout this portion of the Basin, and to attempt to fit them into the regional geologic picture.

Many ideas were undoubtedly changed and general thinking on the area revolutionized by the drilling of the discovery well in what is now the Benedum field, and by the deep wildcat well, Wilshire Oil No. 23-148, which penetrated the Ellenburger at a depth of 13,800 ft and was plugged back to be completed as a small producer in the Wolfcamp. The subsequent increased tempo of deep exploration has accounted for several major discoveries and this with the information uncovered by the present wildcat activity, will yield much knowledge toward unravelling the structural and stratigraphic problems of this part of the Midland Basin.

Engineering Aspects

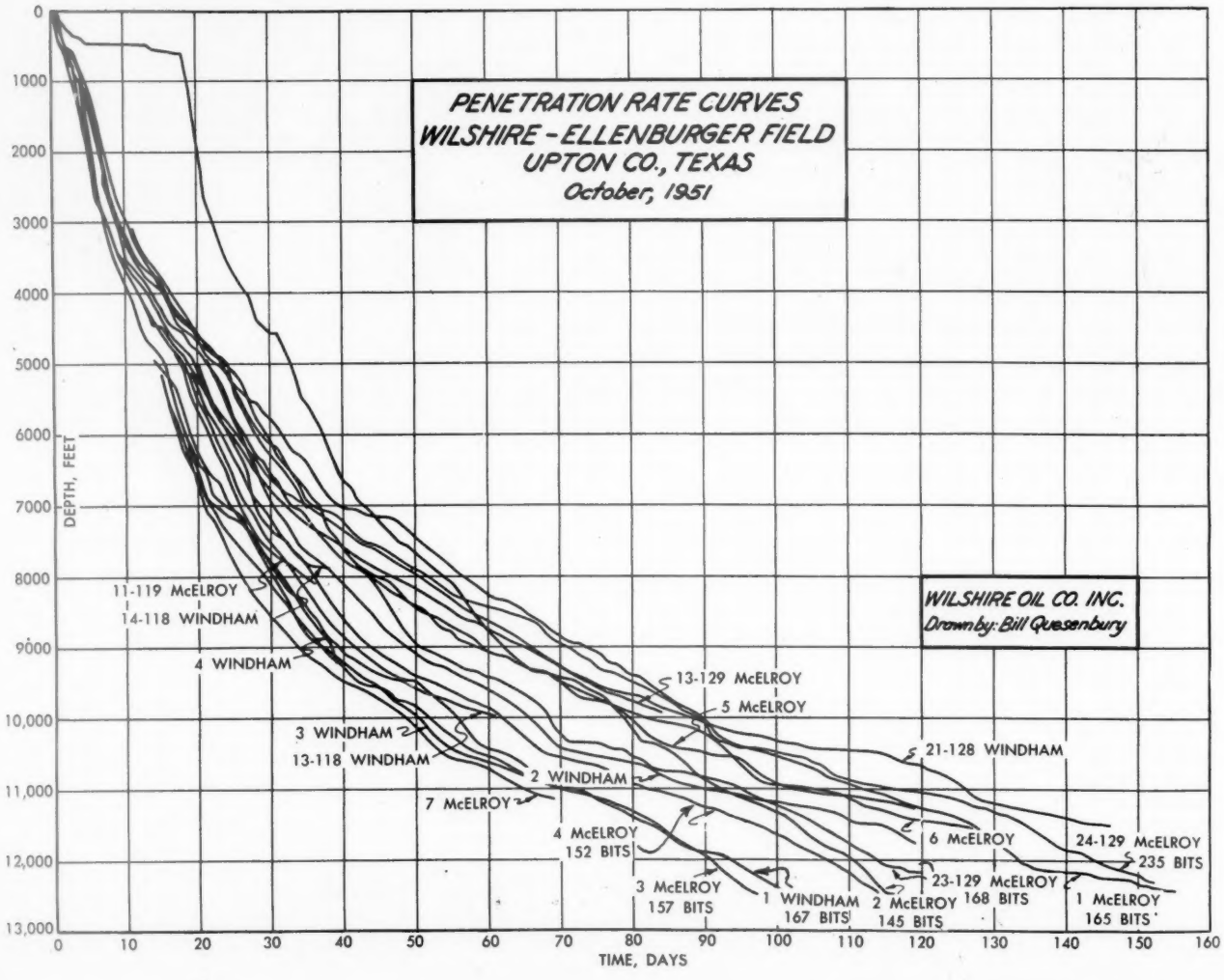
(1) *Drilling Activity.* Currently, there are 16 rigs active in development of three operators' properties in the Wilshire-Ellenburger field. Fig. 8 shows a rig in operation capable of 13,000-ft penetration in this field. Based on the results obtained from 7 completions, it appears that representative drilling time will be of the order of 120 days. A family of drilling rate curves is shown in Fig. 9, which includes the total number of bits required from surface to approximately 12,500 ft. Development well costs are approximately $250,000.00.

(2) *Drilling Problems.* Major drilling problems to date appear to be, in the order of severity, crooked hole, chert, and water supply. Various techniques have been employed in an effort to maintain a hole within the usual five degree inclination limit from 8000-12,500 ft without any marked success. Crooked hole trouble seems to be more prevalent on the westerly flank of the structure that is conjectured to be a result of faulting and/or stratigraphy. Irrespective of the cause, the application of numerous remedial practices including limiting weight on the bit, varying speed of rotation, varying the number of drill collars, incorporating stabilizing devices in the drill collar string, and running of special bits, has not met with success. It is of interest that two 7-in. oil strings have been run in holes in excess of eight degree deviation with no trouble.

Intervals of chert in this field are defined as those cherty zones in which penetration is limited to less than 3 ft per hour and in which bits net less than 12 to 16 ft per run. An average of 12 to 14 days of chert drilling is encountered in penetrating the representative section. Some operators are providing a chert clause to extenuate this difficulty under the terms of the usual footage contract. At present perseverance of effort using standard hard formation bits appears to be the most practical approach toward overcoming this difficulty. Some measure of relief toward penetrating the Devonian and Silurian chert sections is in sight through the use of an experimental chert bit under development by a major bit manufacturer. Although very few of these particular bits have been run, results suggest that their use will result in footages of the 80 to 90 ft range in a 20 to 30 hour rotating period.

An adequate supply of water for drilling has posed a serious problem. In the early development, it was necessary to purchase and transport water by tank truck and this practice is, to some degree, being followed today in order to augment a limited water well capacity. Location of water wells at the junction of the major surface drainage areas as indicated from aerial photographs has resulted in development of a shallow (100-150 ft) subsurface water supply within a few miles of current development. The low recharge factor, however, will undoubtedly render these

FIG. 9. Penetration rate curves in Wilshire-Ellenburger field.



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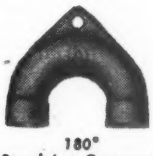
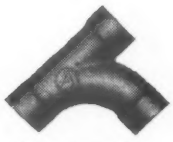
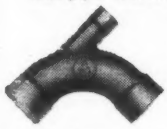


180° Standpipe Gooseneck



Long Sweep Tee



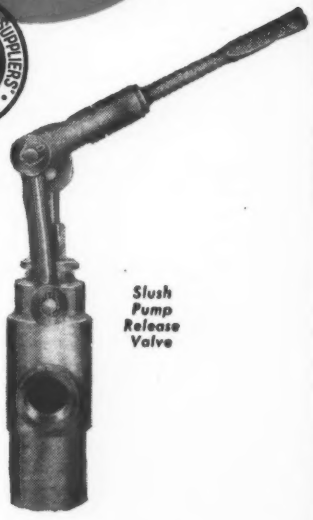
Long Sweep Ell with 2" Outlet

Long Sweep Full Flow Tee

Long Sweep Ell plain 90°

Long Sweep Ell plain 45°

Slush Pump Compounding Valve



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sources of relatively short life. Thought is being given to the construction of small surface water reservoirs topographically above present water wells in an effort to stimulate the natural replenishment of subsurface water.

The usual practice with respect to drilling fluid properties is to endeavor to drill with water to approximately 9000 ft, or immediately above the Pennsylvanian, and carry a fresh water bentonitic mud to total depth of about 12,300 ft. In an effort to minimize washing out of the salt section, 6 to 800 lb of salt are often mixed in drilling below the Rustler anhydrite. Also, sodium dichromate is carried in the drilling fluid as a corrosion mitigation measure while penetrating the salt section to the intermediate casing seat. A noticeable saving in pump parts has resulted from this practice and it is surmised that the drill pipe is deriving some benefit. Mud properties which appear satisfactory from 9000 ft to total depth are of the general order of 9^0 to 9^6 lb per gallon weight, less than 200 seconds Marsh funnel viscosity, and filter loss of 10-15 cc. It is most desirable to maintain low gel strengths commensurate with depth. Hole trouble stemming from the apparent sloughing of Mississippian and Pennsylvanian shales has been encountered. This is believed to be largely mechanical rather than due to mud characteristics. Competent mud supervision and further experience should result in a mud expenditure of less than $6000 per well.

Casing programs involving approximately 200 ft of surface casing, 4800 ft of intermediate casing, and 12,300 ft of production casing are required. Availability has dictated the selection of casing sizes to a large degree and a program utilizing a 7-in. oil string has been most widely practiced. Protection of fresh water sands and the oil string is accomplished by circulating cement on both the surface and intermediate casing strings. Varying degrees of success has been obtained by the use of perlitic admixtures and high gel content to lighten the cement slurry. A departure from the usual 7-in. casing string design has been introduced in order to forego the use of a limited supply of extreme line casing. Two strings of 7-in. LT&C N-80 casing have been run in accordance with the design shown in Figs. 10 and 11. It will be noted that latitude in tensional safety factor has been incorporated plus a decrease in computed loading resulting from the bouyancy effect of the mud.

A two rig program has been practiced in the drilling of several wells in the field. This consists of employing a 7500 ft rig in drilling to approximately 4800 ft and running of the intermediate string. A 13,000 ft rig, through skid operations, replaces the smaller rig for the remainder of the hole. This practice is with a view to engaging equipment at its design level and has proved practicable because of rig unitization which affords expedient skidding.

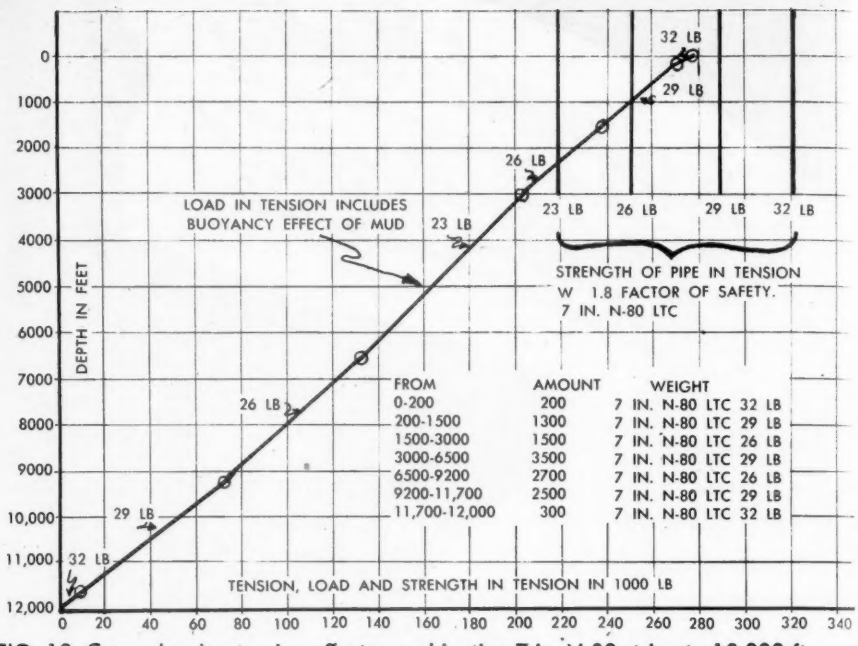

32 LB
29 LB
26 LB
23 LB
LOAD IN TENSION INCLUDES BUOYANCY EFFECT OF MUD
23 LB 26 LB 29 LB 32 LB
STRENGTH OF PIPE IN TENSION W 1.8 FACTOR OF SAFETY. 7 IN. N-80 LTC
DEPTH IN FEET
FROM AMOUNT WEIGHT
0-200 200 7 IN. N-80 LTC 32 LB
200-1500 1300 7 IN. N-80 LTC 29 LB
1500-3000 1500 7 IN. N-80 LTC 26 LB
3000-6500 3500 7 IN. N-80 LTC 29 LB
6500-9200 2700 7 IN. N-80 LTC 26 LB
9200-11,700 2500 7 IN. N-80 LTC 29 LB
11,700-12,000 300 7 IN. N-80 LTC 32 LB
TENSION, LOAD AND STRENGTH IN TENSION IN 1000 LB

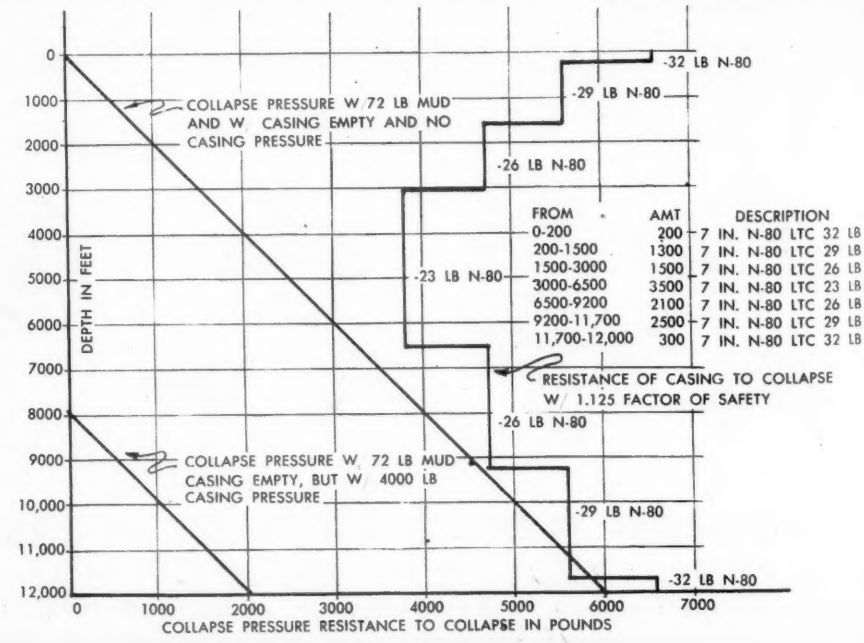
FIG. 10. Curve showing tension effects, combination 7-in. N-80 string to 12,000 ft.

Production. Field rules promulgated by the Texas Railroad Commission require a minimum distance of 1320 ft between wells and 660 ft from property lines, thus affording a maximum well density of 40 acres per well. The allocation formula attributes 75 per cent to acreage and 25 per cent to the well under a top well allowable of 550 bbl per day. The limiting gas oil ratio has been set at 1500 std. cu ft per barrel of stock tank oil.

At present there appears to be two major trends of thought among the operators in this field with respect to anticipated reservoir performance as reflected by current well completion practices in dealing with an undersaturated crude; namely, (1) open hole with minimum penetration and (2) setting through and selective perforating approximately 300 ft below the top of the Ellenburger. If the principal reservoir mechanism should be expansion of the reservoir hydrocarbons with little or no water influx and poor vertical communication, the latter practice could, perhaps, prove the optimum. On the other hand, open hole completion should result in less remedial work and greater ultimate recovery under conditions of good vertical communication and a highly effective water drive.

Despite what dominant reservoir mechanism production-pressure history should reveal, the foregoing completion practices infer the acute awareness of the operators toward the relation, proved

FIG. 11. Chart showing collapse effects, combination 7-in. N-80 TC to 12,000 ft.


-32 LB N-80
-29 LB N-80
-26 LB N-80
-23 LB N-80
COLLAPSE PRESSURE W 72 LB MUD AND W CASING EMPTY AND NO CASING PRESSURE
COLLAPSE PRESSURE W 72 LB MUD CASING EMPTY, BUT W 4000 LB CASING PRESSURE
FROM AMT DESCRIPTION
0-200 200 7 IN. N-80 LTC 32 LB
200-1500 1300 7 IN. N-80 LTC 29 LB
1500-3000 1500 7 IN. N-80 LTC 26 LB
3000-6500 3500 7 IN. N-80 LTC 23 LB
6500-9200 2100 7 IN. N-80 LTC 26 LB
9200-11,700 2500 7 IN. N-80 LTC 29 LB
11,700-12,000 300 7 IN. N-80 LTC 32 LB
RESISTANCE OF CASING TO COLLAPSE W/ 1.125 FACTOR OF SAFETY
DEPTH IN FEET
COLLAPSE PRESSURE RESISTANCE TO COLLAPSE IN POUNDS

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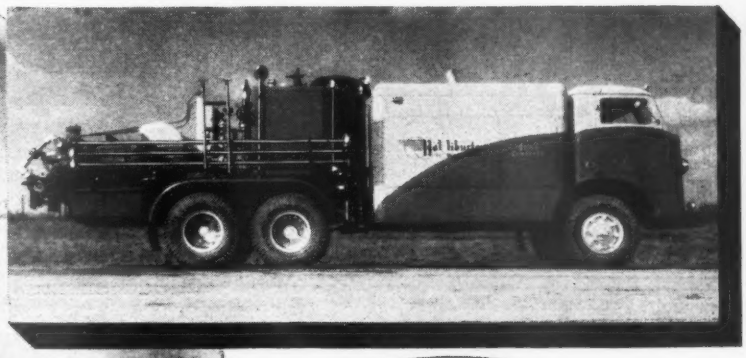

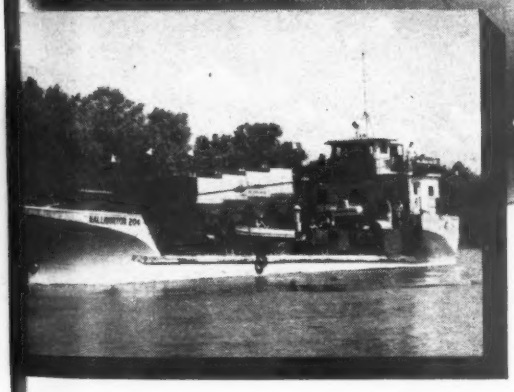

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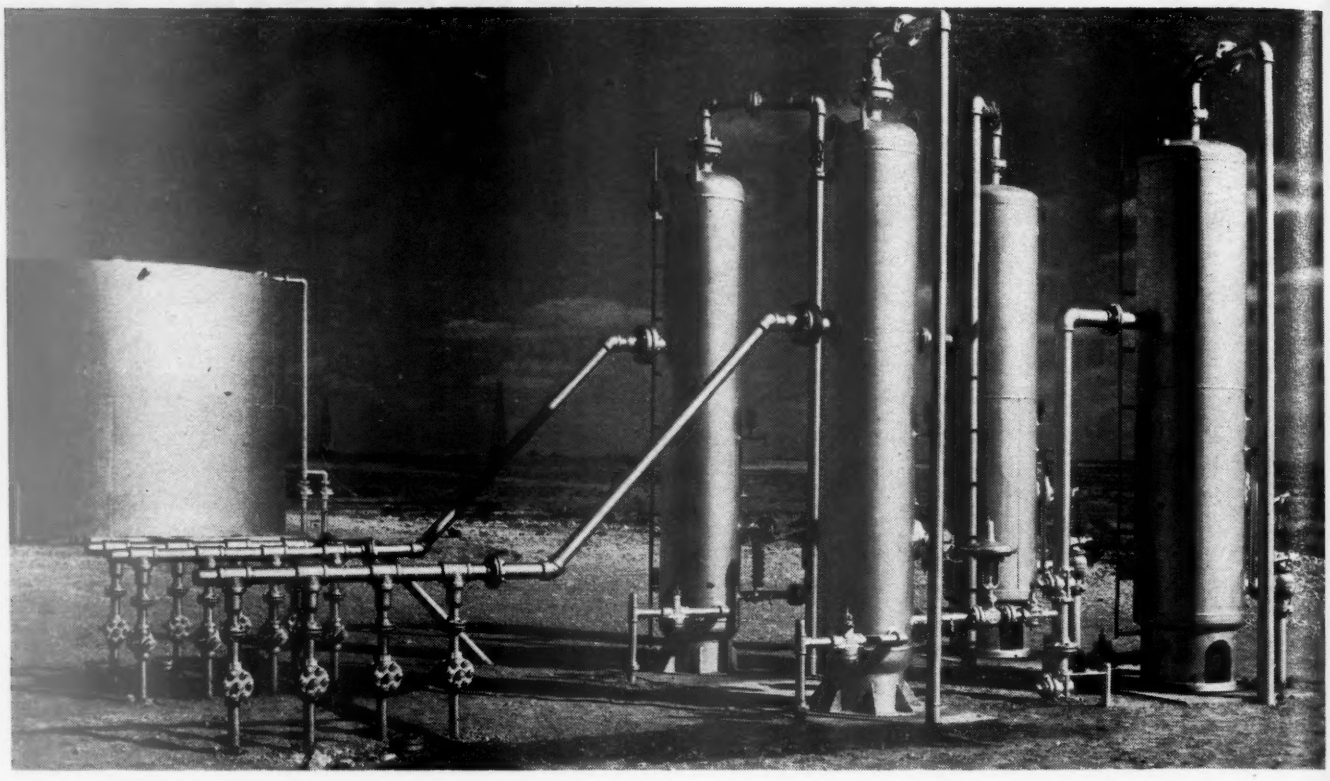

FIG. 12. Wilshire's McElroy tank battery.

by experience, of optimum recovery resulting from controlling the behavior of a reservoir during its producing life and initiating well considered completion practices early in development.

Utilization of produced gas has influenced separator installation as shown in Fig. 12. Originally it was planned, through the installation of two stage separation, to conserve all high pressure gas in excess of drilling fuel requirements by diverting approximately 260 cu ft per barrel of 600 psig first stage gas to a pipe line under an exchange agreement pending a gas processing plant. In the interim, however, arrangements were made and construction is in progress for the installation of a 20,000,000 cu ft gasoline plant to be on stream before April 1, 1952. This was possible under the present scarcity of materials by the acquisition of an existing, but inactive plant, of suitable design.

Reservoir Data

The limits of production are yet undefined, however, the apparent field water level is indicated at —9719 ft subsea, which results in a presently known oil column of 541 ft.

The initial static bottom hole pressure in the discovery well, Sinclair Oil and Gas Company's McElroy No. 1, was recorded as 5386 psig at a —9500 ft subsea datum. A subsequent field static pressure survey disclosed a five well arithmetic average bottom hole pressure of 5397 psig after a 48 hour shut-in period. Cumulative reservoir withdrawal was 140,000 stock tank barrels between the foregoing pressure observations. Instrument variation probably accounts for this discrepancy.

Analysis of a reservoir fluid sample showed this to be an undersaturated crude exhibiting a saturation pressure of 1805 psig with 932 SCF per barrel of gas in solution. At saturation pressure the formation volume factor was determined to be 1.642 with a viscosity of 0.300 centipoises at reservoir temperatures of 202 F.

Only one well has been cored in the Ellenburger pay section. Analysis of this core suggests approximate physical properties of 2-3 per cent porosity, 10-15 millidarcy permeability, 10 per cent residual oil saturation, and 15 per cent interstitial water saturation.

The productivity of wells completed is exhibited in the tabulation of potential test data shown in Table I. In weighing the potential test gas-oil ratios, a field average of 726 std. cu ft per barrel is obtained, which is characteristically low for a crude of 51.5 API gravity. Gross productivity indices have ranged from 1.58 to 3.97 at rates of production of from 377 to 2185 bbl per day. Pressure build up tests were run in conjunction with productivity indices measurements. Maximum pressure build up occurred in 25 minutes in one well following a 1920 bbl per day flow rate.

Following the completion of the discovery well, the operators, in recognition of the potential magnitude of this field, organized an engineering-geological committee as an informal advisory body for the purpose of commuting technical data and recommending to the respective managements co-operative acquisition of data in a standard and orderly manner. It is believed that this early approach toward seeking to define and understand this reservoir will enhance the efficiency of development and operation.

Table 1. Wilshire-Ellenburger field, Upton County, Texas. Tabulation of potential test data.

Operator and lease	Well No.	Date of test	Producing method	Choke size	Pressures Tbg.	Csg. B	Csg. end	Hours on test	24-hr bbl pot.	Production during test Water bbl	Production during test Oil bbl	Gas-oil cu ft per bbl
Wilshire-McElroy	23-129	8-8	F.	1"	500	125	125	24	2551	0	2551	703
Wilshire-McElroy	24-129	9-20	F.	2-1"	600	700	700	14	4160	0	2420	659
Sinclair-McElroy	1	4-23	F.	½"	150	775	775	24	1681	0	1681	770
Sinclair-McElroy	2	8-28	F.	2"	200	1200	1200	15	3490	0	2184	719
Sinclair-McElroy	3	7-25	F.	2"	300	310	310	24	2584	122*	2584	775
Sinclair-McElroy	4	10-5	F.	**	100	0	0		743			810
Sinclair-Windham	1	7-19	F.	1"	125	0	0	24	913	0	913	828

* Filtrate. ** Not Available.

Acknowledgments

The authors wish to express their appreciation to M. A. Machris, vice president of the Wilshire Oil Company, Inc., and F. W. Lake, vice president and manager of the Texas division of the Wilshire Oil Company, for permission to publish the above article. Grateful acknowledgments are offered to H. L. Williams of the paleontological laboratory, Midland, Texas, and to the members of the engineering and geological staff of the Texas division of Wilshire Oil for their constructive criticism. ★

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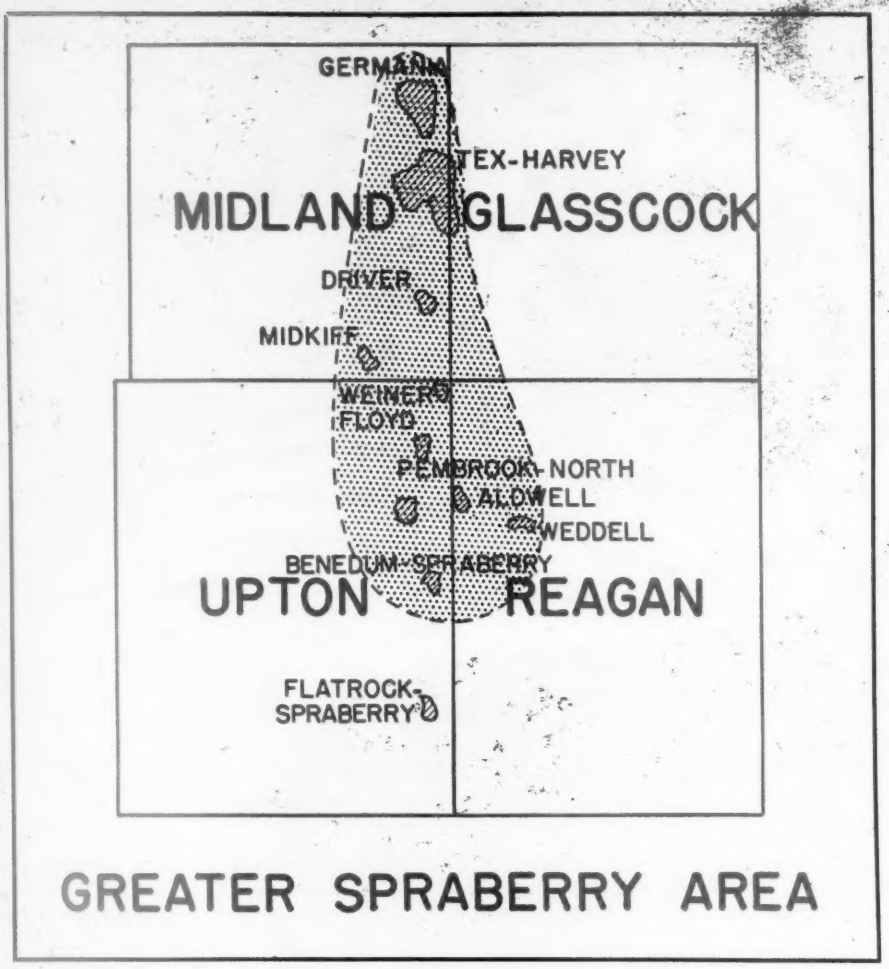

HYDRAFRAC—
The Spraberry Stimulant

An evaluation of the Hydrafrac process as used in the Spraberry

WALDO L. GROSSMAN

APPLICATION of the Hydrafrac process as a means of stimulating production from Spraberry wells was one of the major factors of the rapid expansion in exploitation of the Spraberry sandstones that have produced the world's largest oil field. The "Greater Spraberry field" covering some 1,000,000 acres in Midland, Glasscock, Upton, and Reagan counties includes the Germania, Tex-Harvey, Driver, Midkiff, Weiner-Floyd, Aldwell, Pembrook North, Pembrook, Weddell, and Benedum Spraberry fields. Initial Spraberry production in this area was the discovery of the Tex-Harvey field in February 1949. In September 1950, nineteen months later, the first Hydrafrac treatment was applied to a Spraberry well in the Midkiff field. At that time, 19 Spraberry wells producing less than 40,000 bbl of oil per month were on production in that area. By December 31, 1951, sixteen months after the initial Hydrafrac treatment, over 1500 Hydrafrac treatments have been given to Spraberry wells in the area. Over 850 wells are now producing over 2,000,000 bbl of oil per month.

Hydrafrac stimulates production by increasing effective permeability of the producing formation to the well bore. The formation treated is fractured and these fractures extended or existing fractures are extended. The fractures produced and/or extended are held open by a propping agent. A viscous fluid is prepared by mixing kerosine with an oil soluble soap. A round grained, uniformly graded quartz sand of about .020 in. diameter grain size is added to the viscous fluid. This material is pumped into the zone to be treated at sufficient rate to produce pressures at the formation to fracture and/or extend fractures. The viscous fluid is an unstable material that reverts back to a thin fluid within 24 hours. Special chemicals are generally added to crude oil, normally twice the volume as that of viscous fluid, which produce a breaker fluid. Breaker fluids serve as insurance for a breakback of the viscous fluid. The breaker fluids are displaced into the formation with crude oil.

The size of successful treatment has varied from 1500 gal to 10,000 gal of viscous fluid per treatment. Amounts of sand used have ranged from the normal ½ lb per gallon to 2 lb per gallon, or from 800 lb to 20,000 lb per treatment. Amounts of crude oil breaker fluid have ranged from none being used to 400 bbl. The average treatment now being used would consist of about 2500 gal viscous fluid plus 1400 lb of sand (5 per cent above normal 400 lb per 750 gal viscous fluid) and following by 4500 gal breaker fluid (90 per cent of normal ratio of 1500 gal per 750 gal viscous fluid).

About 85 per cent of all treatments have been in open hole. Of these, about 25 per cent were below a packer set in the casing, 25 per cent were below a single anchor packer set in the open hole, about 45 per cent were between a hydraulically operated straddle packer set in the open hole and about 5 per cent were performed with no packer and in some cases, no tubing. Treatment through casing perforations have been about 75 per cent below a single casing packer and about 25 per cent between straddle type packers.

A large number of wells have been completed from the Spraberry. A great variety of drilling practices have been employed to penetrate the productive formation. Numerous methods of Hydrafrac treatment application have been used to stimulate production. This work has extended over a large area. Much

The Author

Waldo L. Grossman, division engineer for Halliburton Oil Well Cementing Company, Midland, Texas, is a graduate of the University of Oklahoma. Upon receiving his BS degree in petroleum engineering in 1951, he joined Tide Water Associated Oil Company, working in South Louisiana and West Texas for 3 years. He served three years in the U. S. Navy during World War II, and in 1946 was employed by Halliburton in his present capacity.

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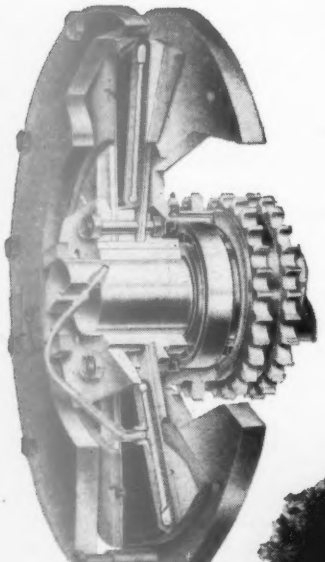

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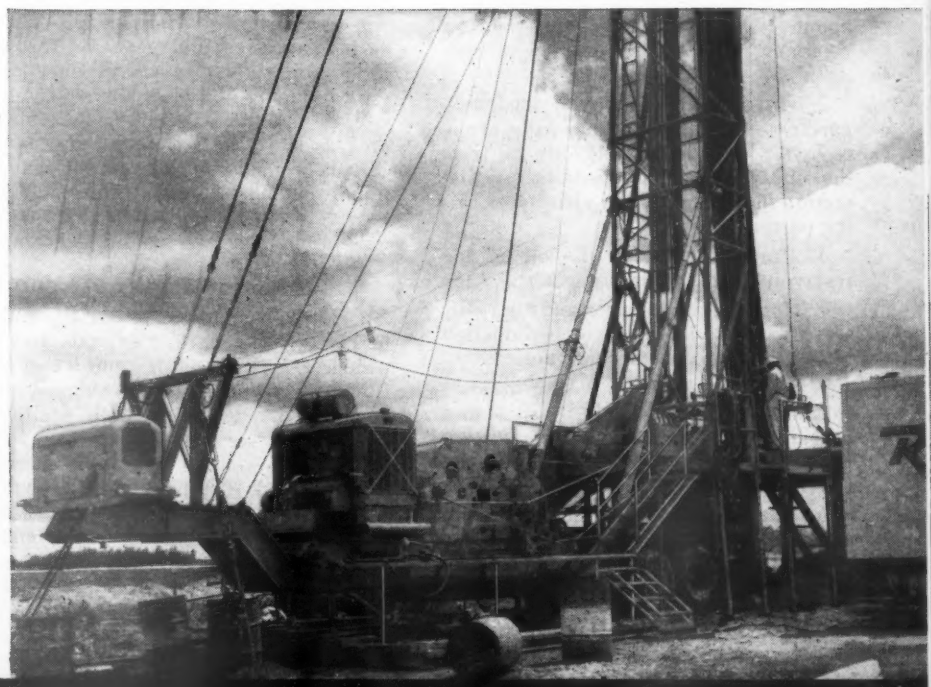

Driller's position at base of mast gives full visibility. Mast is erected by hydraulic system and raised to full height with traveling block and drilling line.

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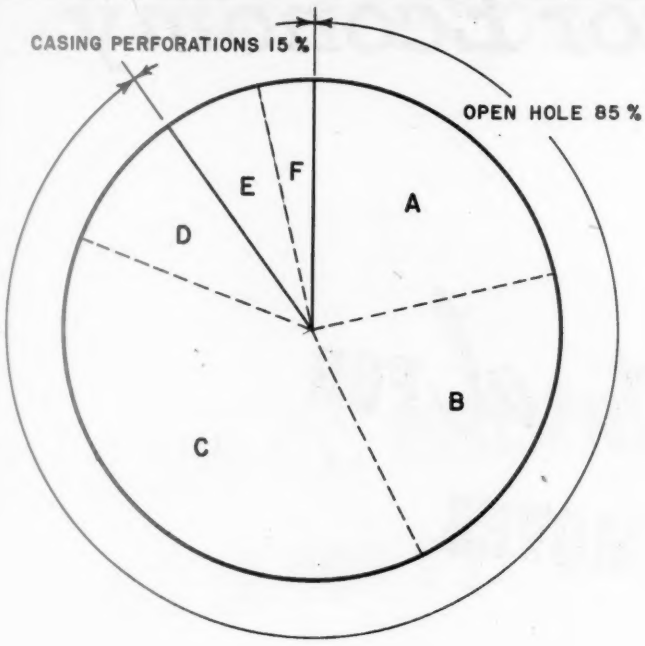

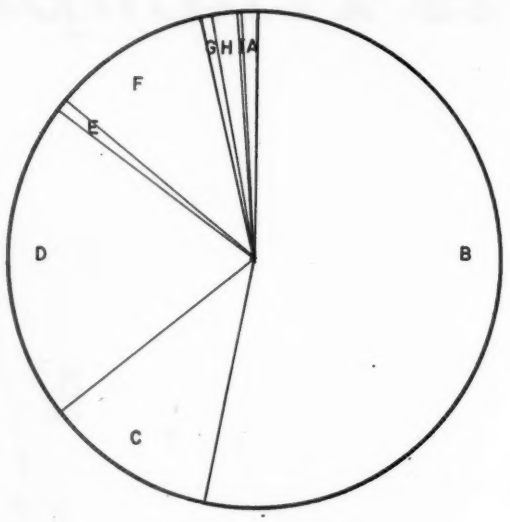

A CASING PACKER	25 %	D NO PACKER	5 %	A 750 GAL.	1.0 %
B FORMATION ANCHOR PACKER	25 %	E CASING PACKER	75 %	B 1500 GAL.	53.2 %
C STRADDLE PACKER	45 %	F STRADDLE PACKER	25 %	C 2250 GAL.	11.0 %
				D 3000 GAL.	20.9 %
				E 3750 GAL.	0.7 %
				F 4500 GAL.	10.6 %
				G 5250 GAL.	0.6 %
				H 6000 GAL.	1.9 %
				I ABOVE 6000	0.1 %

Method of Treatment Application
September 1950 through September 1951

Size of Treatment
Gallons viscous fluid

remains to be learned about this great oil reservoir. Although they will not be agreed to by all operators in the area, the following general conclusions seem to appear true.

General

1. The entire Spraberry section of about 1000 ft thickness may be one reservoir over the "Greater Spraberry Area".

2. On an individual well basis, regardless of the unity or non-unity of the reservoir, production will only be from the uncased open hole section or that section in the immediate vicinity of casing perforations.

3. Practically all of the oil in the reservoir is in the sandstone.

4. The natural fractures and/or joints serve as pipe lines for oil production from the matrix to the bore hole.

5. Setting production casing at least to the top of the lower Spraberry and possibly through the entire section would be most desirable because of the following factors:

A. Many operators must use 5½-in. OD production casing.
B. Mechanical problems of drilling 1000 ft of 4¾-in. open hole for production purposes.
C. Problem of maintaining a 1000 ft section of open hole for production purposes during the life of the well regardless of size of production casing.

6. Drilling of the production section with cable tools or reverse circulation using Spraberry crude oil for circulation has been the most successful method. The fear of damaging wells by drilling the section with water or muds is decreasing, however. The use of emulsion muds and close control of mud and rig operation will probably prove that casing can be set and cemented through the producing section without damage to the producing ability of the well.

7. Designation of a well in the general area as a dry hole from the Spraberry cannot be made on the basis of conventional methods. Samples, cores, various logging methods, drill stem tests or natural production tests are not conclusive.

Artificial Stimulation

1. Hydrafrac treatment of the Spraberry section generally extends and/or widens existing fractures and leaves the fractures extended and/or widened held open by the deposition of a propping agent.

2. An oil squeeze will apply a pressure of about 1000 psi above the hydrostatic at the bottom of the hole. Oil squeezes have not proved commercially successful.

3. Hydrafrac treating pressures are generally lower than that considered necessary to create a fracture in a formation at these depths. They are sufficient to extend and/or widen existing fractures. Pressure on the formation when injecting viscous Hydrafrac fluids range from 100 to 500 psi more than that obtained with an oil squeeze.

4. Injection rates when increased from 3 to 5 bbl per minute to 10 bbl per minute do not increase the pressures at the bottom of the hole appreciably, nor have the results of treatment indicated any benefit or damage from high injection rate treatment.

5. Size of treatment—1500 gal of viscous fluids has proved minimum size for successful treatment up to 100 to 150 ft of open hole section. If 150 to 250 ft of section is open, 3000 to 4500 gal treatment has been more successful.

6. Use of sand for propping agent is probably the major factor in obtaining a successful treatment. Increasing the concentration over the normal ½ lb per gallon to as high as 2 lb per gallon has been tried but not evaluated.

7. Use of breaker chemicals has been reduced by one half on many jobs and has been left out of several altogether. No job failures have resulted because of elimination of this part of the normal Hydrafrac treatment. This procedure is not recommended for other producing formations.

8. Definite evaluation of proper method of treatment application has not been accomplished. Initial production for wells treated over comparable sections by single treatment or multiple selective treatment has been about the same. Many people believe that production decline will be less as a result of selective multiple treatments. * * *

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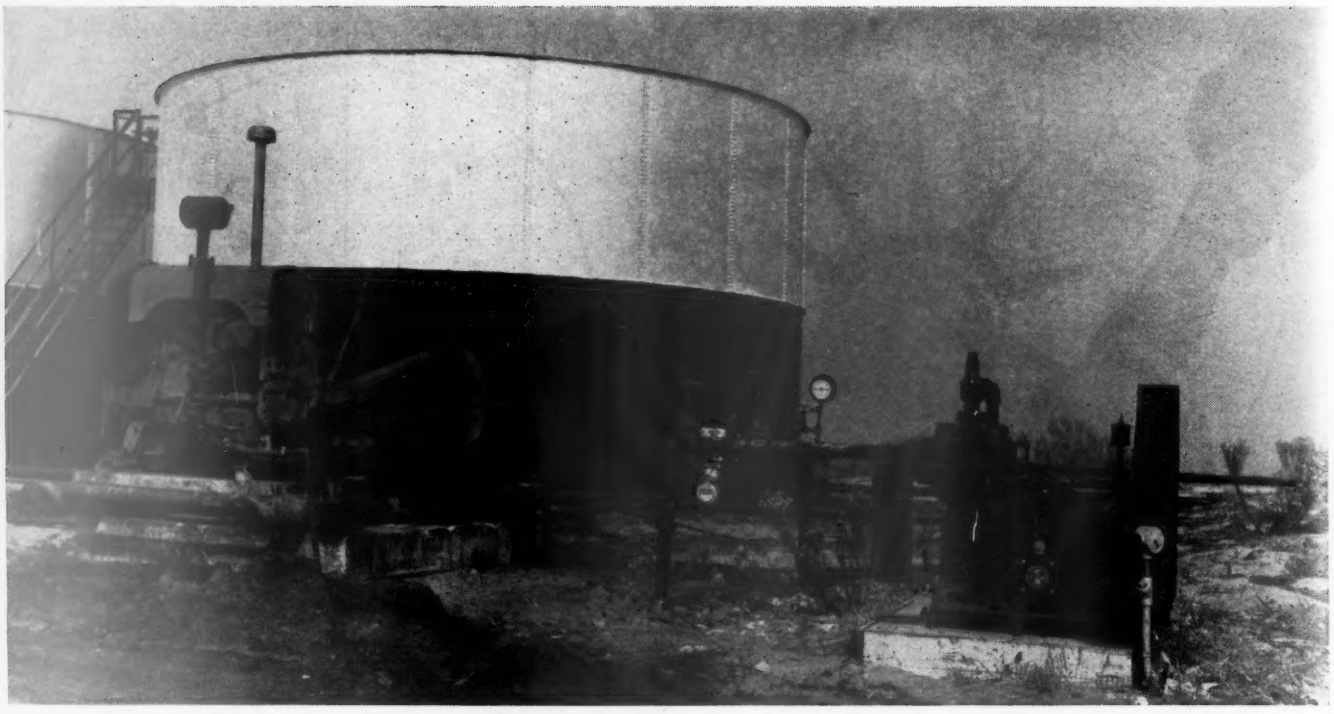


Electric pump and stand-by gas engine pump used to maintain 100 lb pressure on 5 miles of 2-in. pipe system used to carry diluent to 13 wells on the Bradley Lands Two lease at Santa Maria.

Diluent Injection Aids Heavy Oil Lift

Use of a diluent in Union Oil's Santa Maria field has solved the problem posed in lifting extremely heavy oil

WILLIAM T. RINTOUL

HEAVY oil is a common commodity in the Santa Maria Valley field, about 160 miles to the north of Los Angeles, California, where only four of the field's more than 350 wells produce crude with a gravity as high as 16 deg API. The average gravity of the oil produced is between 12 and 13 deg, as a matter of fact, and there is some of it that according to local lore "you can walk on."

One can, of course, pump 12.5 API gravity oil without resort to any particularly novel technique, although it is never the best kind of operation for workers who have been imbued with the virtue of good housekeeping. There are, however, on one certain lease a total of 13 wells that pose a real production problem. These wells produce six to nine gravity oil that is so viscous it is practically plastic and it can not be lifted by any of the ordinary methods. The means by which it is actually brought to the surface is just another evidence of the resourcefulness of the oil operator and his faculty for solving the problem of the moment with the tools at hand.

Union Oil Company of California is the principal operator in the Santa Maria Valley field, and is the lessor of the property on which the 13 wells that produce the extremely heavy crude are situated. By a novel device, Union has successfully overcome the inherent difficulties of the situation and is now producing these wells economically, continuously, and with the minimum of discomfort through the use of a diluent.

The effectiveness of the diluent is reflected in daily production figures. Of the average 6500 bbl of crude produced daily by Union Oil Santa Maria Valley field, these 13 wells, constituting 3.7 per cent of the total, produce more than 10 per cent of the oil raised. Actually, they account for some 850 bbl daily, which is over 13 per cent.

All the 13 wells are on the Bradley Lands Two lease, a quarter section parcel about 3 miles southeast of the town of Santa Maria. Average depth of the wells is 5500 ft, and production ranges from 20 bbl to 180 bbl per day of native crude.

Although the heaviest oil produced by the 13 wells on this property is considered to have a gravity of 6 deg, it is practically impossible to get an absolutely accurate field test because of the difficulty of obtaining a sample of native crude without the use of diluent.

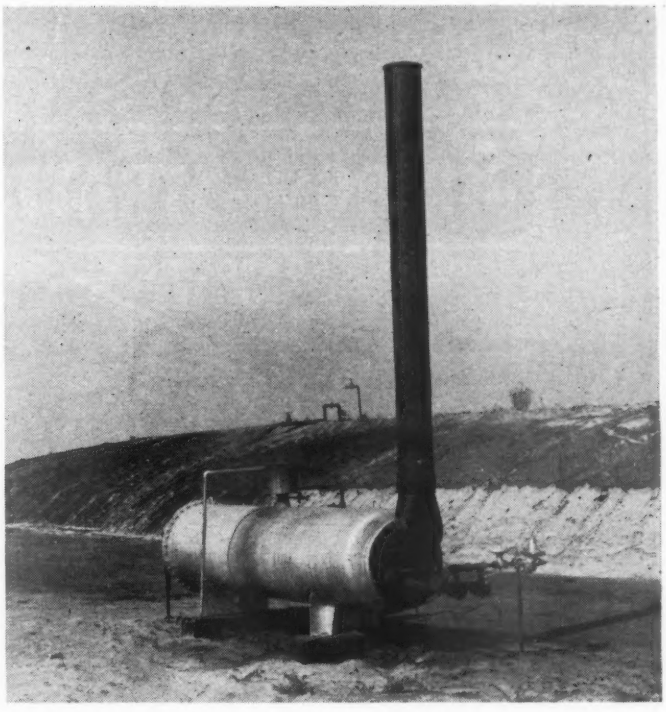
The diluent, a 21 API gravity crude, brought in from the Orcutt field to the south of Santa Maria Valley, is piped to the latter through a 5-mile, 6-in. spur line that branches off the main line from Orcutt to the shipping terminal at Avila, California. Three 2000 bbl storage tanks are used to hold the diluent prior to its use on the Bradley Lands Two lease.

About 25 to 33 per cent of the output from the heavy crude wells is diluent. If a well pumps approximately 200 bbl, for example, 40 to 50 bbl of diluent will be drained into the hole each day.

Five miles of 2-in. line carry the diluent from the storage tanks to the wells on the Bradley Land Two lease. An electric pump is used to maintain a pressure of 100 lb on the diluent pipe system. A small injection pump attached to the well pump in each instance feeds the diluent to the well. Diluent is pumped into the well, which is open to

EXCLUSIVE

Ten-ft surface stroke employed by massive pump unit used to produce six to nine degree gravity oil from a 5500-ft well in the Santa Maria Valley field.



Small boiler used to heat diluent to about 150 degrees before its injection into a heavy crude well in the Santa Maria Valley field.

atmosphere, and gravity does the rest.

The lean diluent is injected into each well between the casing and tubing strings and the enriched diluent, or commingled oil, is produced through the tubing. Surface equipment plays an important role in producing heavy crude. The pumping units are of the type commonly referred to as tail pumps. They are of necessity big and heavy, varying somewhat in size but in the main about 640,000 in.-lb, air-balanced units, with a 10-ft stroke.

Experience in operating the wells has indicated that three and one-half to four strokes per minute is the best operating speed. If run faster, too great a load is imposed on the pump unit and fatigue results in the rod or macaroni strings. Average cost of the surface units now being used is $21,000.

After it has reached the surface, the commingled crude is conducted by pipeline to the huge Union Oil Battles plant about a mile north of the Bradley Lands Two lease. Here, as a 12 deg API crude, it is processed and sent on to the port of Avila for shipment by tanker to company refineries at Wilmington and Oleum.

Thirty million cubic feet of gas per day are handled by the Battles plant and an interesting sideline to its routine compression, absorption and purification functions is the extraction of carbon dioxide from the gas throughput.

About 16 per cent of the total gas produced by the Santa Maria Valley field is carbon dioxide. It ranges in individual wells from 4 to 35 per cent, and the heaviest crude wells amount to about 10 per cent.

Carbon dioxide gas is processed in a dry ice manufacturing unit that cost over $750,000, and is a part of the Battles plant. The gas is piped to the dry ice plant under a pressure of 30 psi and is compressed in three stages to about 1000 psi, at which pressure it is liquefied. It is then stepped down, fed to a press in the form of snow, and there is subjected to 250 psi to turn it into a solid.

Capacity of the plant is 64 tons of dry ice per day, with current output averaging around 40 tons per day. Dry ice from the Battles plant is shipped as far east as Kansas City, Missouri, though it finds its principal markets in Los Angeles and San Francisco.

Returning to the handling of the heavy oil, when any one of the 13 heaviest crude wells becomes unbalanced between the mixture of diluent and native crude, that is, has too much native crude in proportion to diluent, it becomes, in Santa Maria parlance, "gunked up," and it is no small job to get it ungunked again.

When a well gets in this condition, it is turned over to one of the well pulling crews. The company maintains three of them in the district, and one is usually to be found on the Bradley Lands Two lease. Each well is pulled once every 60 to 90 days, at an average cost per pulling job of $1000, which includes pulling

Union Oil Company well-puller demonstrates tar-like quality of 6 API gravity crude oil produced on Bradley Lands Two lease at Santa Maria. Thirty min after reaching surface, this oil solidifies to such an extent that it will deflect a rock thrown at it.

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the well, running the bailer, and hooking the well up to the pump again.

Viscosity of the heavy crude makes it necessary for the well pulling crews to "creep" out of the hole with the rod string to avoid pulling it apart. One-inch rod strings have been known to part within 1000 ft of the surface in the heaviest crude wells, and the resultant mess is definitely something the crews want to escape if at all possible.

After watching a pulling crew at work on one of these super-heavy oil producers and noting the character of the oil that clings to the rods, it is difficult to believe that it could be pumped to the surface by any system. Instead of running from the rods, as oil ordinarily does, this viscous heavy stuff sticks to them in large, black blobs, which the crewmen casually wrench off and throw into the sump. If some of the oil falls to the floor of the rig, it is virtually impossible to remove it, and after any bulk quantity has been quiescent for half an hour or so, a rock thrown at it will bounce off the surface and scarcely make a dent.

In order to get the heavy crude oil out of tubing, it is necessary to dip the tubing in a special steam and chemical preparation, heated to boiling point, at the Battles plant. Twenty joints are dipped at a time and kept in the preparation for about half an hour. After immersion, the joints are held up vertically in order to let the crude oil drain out.

Initial production on the Bradley Lands Two lease was "proved up" in 1940, and the most recent well completed last August.

Production is from an anticline overlain with sand through which rapid drilling time can be registered. The average depth of the 13 diluent treated wells is 5500 ft, and average drilling time is 25 to 30 days from spud-in date to completion. Oil-base mud is used to drill through the oil zone, and water presents no unusual problem. The average cut is about 8 per cent.

The heaviest wells have shown no appreciable production drop during the last few years. Operators figure that 20 bbl a day is the minimum for profitable production under the method employed at present heavy oil prices.

It was found necessary to shut in the wells a couple of years ago because of a price drop, but the current rate of approximately a dollar a barrel permits the economic conduct of this operation.

Responsible for operation of the Santa Maria Valley field is Union Oil Company's district superintendent of production and drilling, W. O. Butler, who is aided by R. L. Talley, district production foreman for the Orcutt area.

The entire heavy oil lifting process is merely an application of simple logic. The injection of an effective diluent, produced nearby, is probably cheaper than any known method of heating the oil in place to reduce its flow resistance, and the fact that the diluent doesn't have to be recovered on the spot for recycling is another strong recommendation. * *

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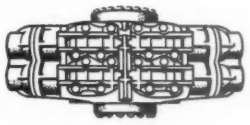
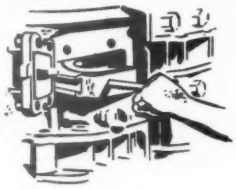


Completely Enclosed Design

All moving parts—even the piston rod ram shafts—are completely enclosed within the body of the Gate. There is nothing to become wedged or damaged by objects falling into the cellar—nothing to become corroded by chemical or salt-mud drippings. Even the locking shaft is non-rising—fully protected!



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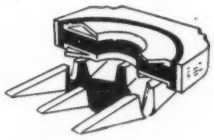
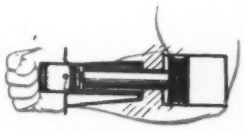
Just unbolt and swing open a side door, slide out the ram assembly, slide in the new assembly, close and bolt the door. It's by far the simplest ram change in any control gate—and complete ram changes can be made whether the pipe is in or out of the hole!



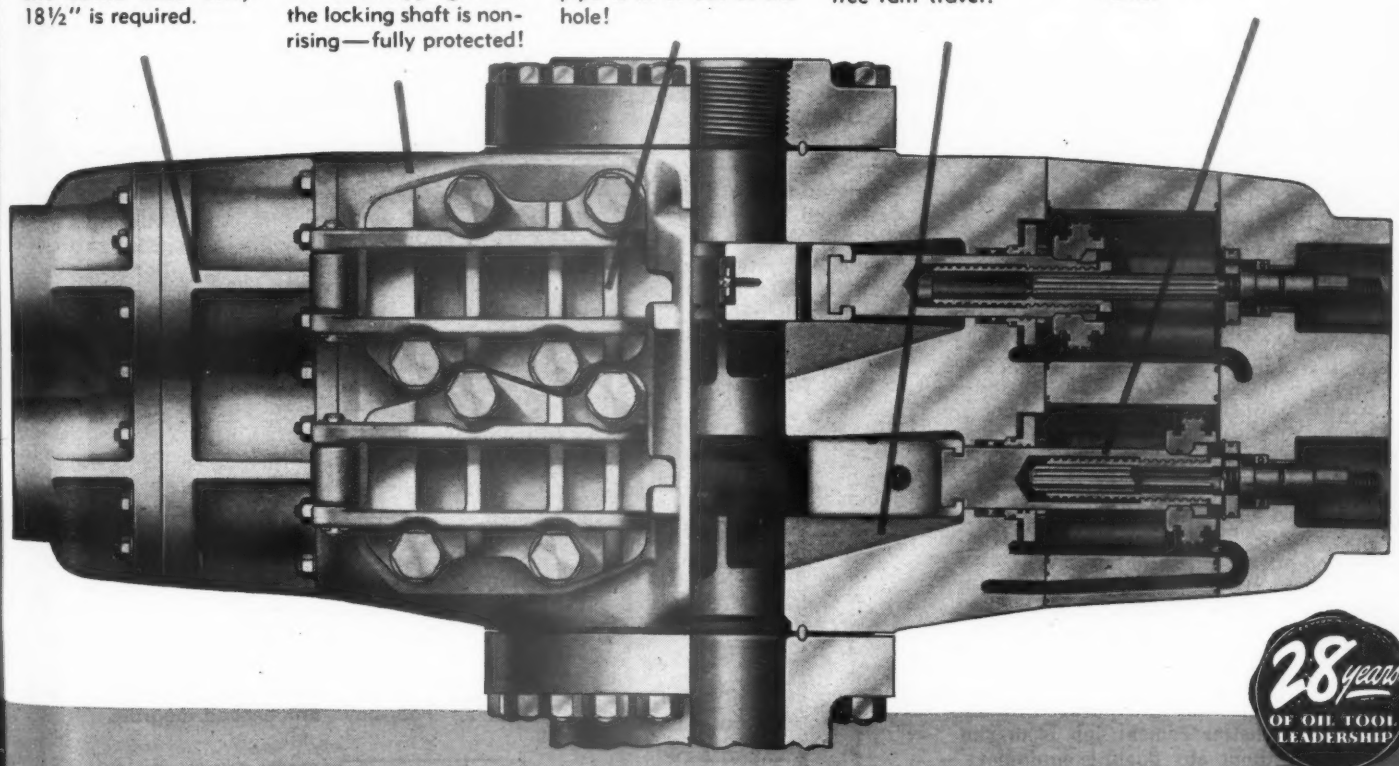
Self Draining Construction

Note how the rams travel on high narrow guide ribs above the steeply-sloped bottoms of the ram compartments. Mud and sand quickly drain back into the well—leaving no detrimental accumulations to interfere with free ram travel!



Direct Hydraulic Drive

Note how the hydraulic operating cylinders are directly behind the rams for positive action, maximum simplicity, greatest safety. There are no complex mechanisms, no yokes, no secondary connections between hydraulic cylinders and rams!



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See the Shaffer section—pages 4525 to 4600—of your 1951 Composite Catalog!

Spraberry Sand Completion Methods

An introduction to completion methods used in "operations occurring below oil string casing point"

HARRY E. LEGENDRE

The objective of this paper, as the title would suggest is more for the purpose of introducing the various completion methods used in Spraberry operations rather than to discuss them in detail. In my brief discussions I will consider only operations occurring below the oil string casing point. This line of demarcation will be considered on the basis of depth rather than chronology as a few operations occur below this point before casing is set.

Operations Before Pipe is Cemented. I have in mind two particular operations that take place before pipe is cemented. These are primarily to prevent mud, lost circulation materials, and cement from contaminating the producing formation. In several wells cement was found in cores or samples to depths of some 150 ft below the casing shoe. Mud and lost circulation materials were also observed at similar depths.

The first method being used to combat this problem is by the use of plastic plugs placed in the bottom of the hole before running casing. This operation is done by the dump bailer method and is fast and economical. From 10 to 25 gal of "filler" plastic are generally used, which results in a "fill-up" of 4 to 6 ft depending of course on the size hole and degree of fracturing. Average cost is approximately $450. Results reported for these precautionary measures show that temperature surveys logged higher cement tops than on other wells in the same area, which means a better cement job and also no contamination of the sand was observed.

The second method being used in an attempt to prevent contamination of the sand and also for the purpose of obtaining a better cement job is to run casing without any floating equipment. This was first begun by removing the balls from the float shoe and float collar, then followed in later wells by boring out the floating equipment, leaving only a stop for the cementing plugs and finally, it is believed, these operators are now running casing without anything but a plain guide shoe.

The general idea behind this method of running pipe was prompted from observations on the derrick floor. It has been noticed that after approximately some 75 per cent or more of the casing has been made up and run that the hole starts taking mud. Usually the condition is so bad that very little or no mud returns are obtained during the course of cementing the casing. It was believed that the casing being lowered into the hole at rather fast rates causes abnormally high pressure to exist momentarily, which breaks down the walls of the hole causing lost circulation troubles. In other words you have a piston effect. I have observed this myself a number of times and in consideration of the large amounts of lost circulation materials used and the high viscosity of mud sometimes necessary, coupled with the "sloughing-off" of the highly fractured shale in the bottom of the hole it is no hard matter to follow the reasoning behind this operation. At any rate several operators are cementing the oil string in this manner and report a minimum of lost circulation troubles and an increase in cement "fill-up" behind the casing.

Operations After Pipe Has Been Cemented. After the oil string has been properly cemented the well is usually "drilled-in" either by (1) reverse circulation, using the rig already on location or a lighter work-over type rig or (2) cable tools. Both methods are being followed. At one time there was a definite trend toward the use of cable tools, however, this does not appear to be the case now. Possibly there are two reasons for this, first, the saturation point has probably been reached as to the availability of cable tool rigs and second, there has been an increased tendency to take in more section. This, according to some operators, makes cable tool operations border on the impractical due to more trouble from cavings, fishing jobs and other difficulties.

In general, either method appears to be equally satisfactory, as far as to end results, however, the cable tools usually give more information as to productivity of the well and so forth, while drilling. The rotary method is usually a bit faster and thereby speeds up operations. I favor the rotary method as it is better for Hydrafrac and/or other completion operations. Also, with new diamond coring equipment, it is possible to core the pay section with high recoveries and minimum expense so that more needed well information can now be obtained. For the most part Spraberry wells are "drilled-in" by reverse circulation, using crude oil as a drilling fluid. A new method is being employed by one operator as an experimental basis whereby compressed air is used as a drilling fluid.

The average time taken for "drilling-in" operations is from 8 to 12 days with some operators reporting as few as 3 or 4. The average Spraberry section cut for completion varies from a minimum of 50 ft to some 220 ft.

In most instances casing is cemented at points varying from the top of the

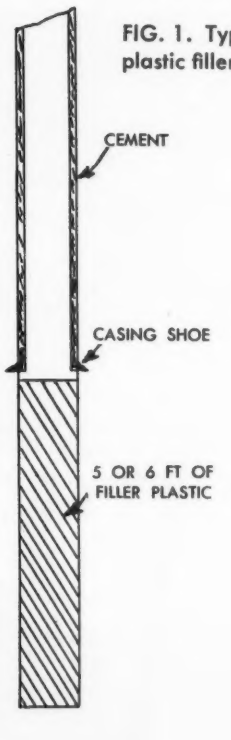
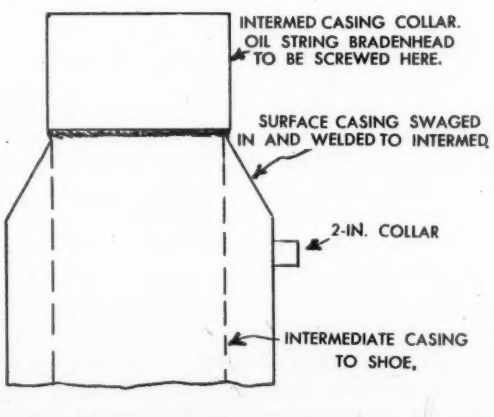


FIG. 1. Typical plastic filler job.

FIG. 2. "Poor-boy" Bradenhead diagram.


INTERMED CASING COLLAR. OIL STRING BRADENHEAD TO BE SCREWED HERE.
SURFACE CASING SWAGED IN AND WELDED TO INTERMED.
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INTERMEDIATE CASING TO SHOE.

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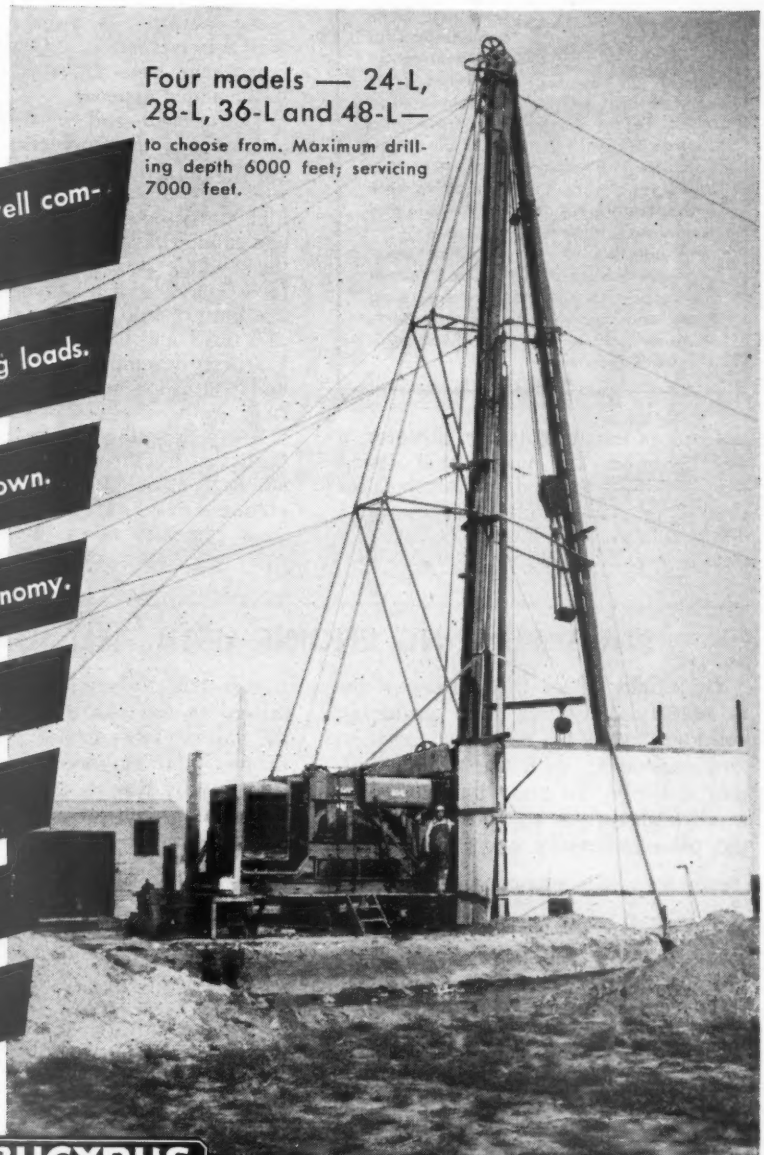
A Bucyrus-Erie spudder will prove it for you eight different ways:

1. Versatility for handling drilling, well completion and workover jobs.
2. Capacity for big tool and casing loads.
3. Easy rigging-up and tearing down.
4. Outstanding maintenance economy.
5. Sharp snappy drilling action.
6. Time-saving mobility.
7. Easy accessibility.
8. Long rope life.



Four models — 24-L, 28-L, 36-L and 48-L— to choose from. Maximum drilling depth 6000 feet; servicing 7000 feet.

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The Author

Harry E. Legendre, petroleum engineer and geologist, is a graduate of Louisiana State University. Since his graduation in 1935, he has worked for Humble Oil and Refining, Union Sulphur and Oil Corporation, and Ohio Oil Company in various engineering capacities. From 1947 to 1951 he was superintendent of West Texas district for Frank and George Frankel in charge of all operations. He left that organization in May of last year to engage in consulting work and operate a bottom-hole pressure and temperature business.

In addition to his consulting work, Legendre has been publishing a factual data report on all Spraberry producing fields, and for two years was secretary-treasurer for the Fullerton Pool Engineering Committee.

sand to as much as 100 ft, however, a few operators are now setting casing through the pay and perforating for completion. This is relatively new and I don't believe they have had sufficient time to evaluate the results of this procedure. Very close mud control is the key to this operation and the mud program probably has been discussed in a previous paper.

Few Spraberry wells offer to produce naturally. Several methods are being used to augment production. The first one tried was the use of nitroglycerin and other special oilwell explosives. This proved to be quite costly due to the long time required to clean out the shot cavings and put the well on production. Some operators, however, are convinced that this method is still the best on a long range basis and are willing to go to the added expense.

The second and most widely used method is by the application of the comparatively new Hydrafrac treatment, whereby the fractures are opened by high pressures using various gel agents and sand. The gel then liquefies, leaving the sand to "prop" or hold the fracture faces apart, which increases the drainage pattern into the well bore.

A third, and I believe, similar method has been developed very recently. As I understand it somewhat different materials are used to obtain similar results.

A fourth method is the use of acid to flush the fractures. This really should not be considered as an ordinary completion method but should be thought of as a remedial effort. Various special acids are being employed to clean the formation of cement, mud, lost circulation materials, or any other foreign materials that might tend to restrict the drainage into the well bore. I have not heard anyone make claim for the use of acid to react on the formation as we think of it in terms of lime wells, but only for the use previously mentioned.

Wellhead

Equipment Being Installed. The equipment being used for completing Spraberry wells is much the same as that being used in other fields. As a matter of fact that is one of the outstanding features that Spraberry operations has in common with other fields.

As a general rule 2-in. tubing is run and a hook-wall packer is set for final completion. The Christmas tree, which is most commonly used, is one that is assembled in the field with store bought valves and connections. This does not mean that the factory assembled trees are not being used. Most trees are in the 2000-lb working pressure and 4000-lb test range. Some few operators are using heavy trees, that would do justice to a high pressure well in the Gulf Coast, having dual master valves, wing valves, and so forth. This is possibly due to strict company regulations more than anything else. These trees are being installed as a rule on simple slip type tubing heads, which in turn are screwed directly on the top of the oil string. In the case of wells using liners a swedge is put between the intermediate casing and the tubing head which is of the same size as the liner so as to be able to pass all tools, packers, and so forth into the well.

Another point might be brought out that might be of interest even though it does not come directly under the subject and that is the type of "poor-boy" bradenhead being used by some operators where only two strings of pipe are at the surface, such as surface and oil string or surface and intermediate casing, where liners are used. This "poor-boy" head is made by slacking off the desired weight on the inside string and cutting deep notches at the top of the surface casing, bringing these into the inside casing and welding everything together. This will make the inner string be welded concentrically to the outer string. A 2-in. collar is then welded to the surface casing and a hole bored inside of it so that the pipe can be tested if needed.

Closing Remarks

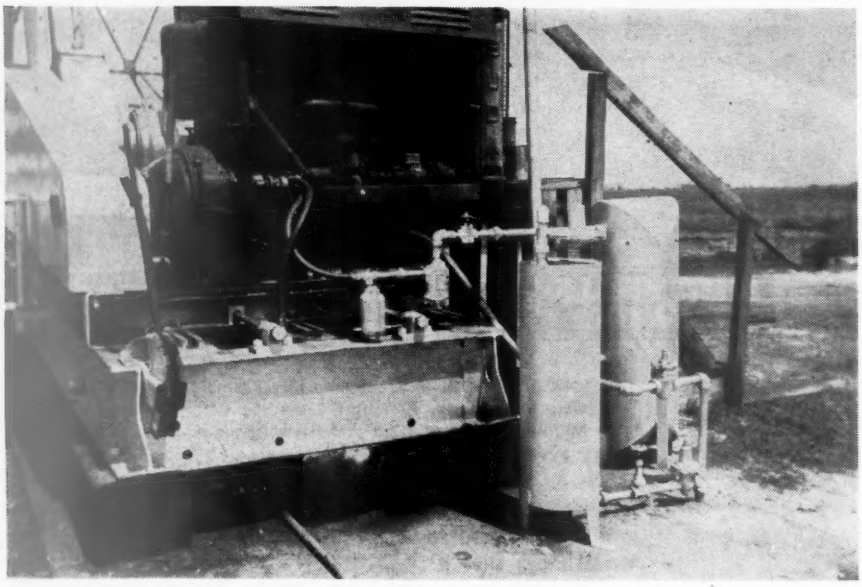
As a whole Spraberry completions require competent and conscientious supervision, men who are always ready for new ways of doing things. This productive formation as you all know is relatively new and we have by no means solved all the problems it offers. The industry is demonstrating, however, by progress to date, that it will measure up to this "Spraberry Monster" and in the end will have new and improved methods by which to remove the valuable crude oil that is now in its possession. * * *

START PUMPING ENGINE WITH FIELD GAS

In a field where high-pressure gas is readily available, one producing company utilizes magneto ignition and does away with the storage battery entirely. To start the engine, a small high-torque air motor is set in the place normally occupied by the electric starting motor, and the high pressure gas piped to the air motor.

Field gas is stored, under high pressure, in a tank set alongside the usual reducer and low-pressure fuel tank, the gas being led through a filter and past a drip collector before being admitted to the starting motor. Use of the volume tank and other safeguards protects the air motor from possible slugging by liquids carried in the gas stream.

A quarter-turn valve is mounted in the starting line, and serves to control flow of gas to the starting motor. Exhaust gas from the unit is carried to a point far enough from the pumping unit to insure against its creating a fire hazard. * * *



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Holman Cartwright (left) watches the first waters flowing from an abandoned oil well on his ranch.

Gas Well Lifts Water

A. B. KENNERLY

EXCLUSIVE

WHAT to do when oil and gas wells stop production is a problem that sooner or later faces most farmers and ranchers. But Holman Cartwright of Live Oak County, Texas, has found the answer.

The field on Cartwright Ranch was opened during the early twenties. Gas was produced in abundance and resulted in one of the first pipe lines into Houston carrying natural gas. Later, oil was produced in moderate quantities.

Now the oil wells have about stopped producing and the gas pressure in several of the gas wells is too low to push gas into the high pressure line.

During the past 30 years Cartwright kept developing his program of growing feed pastures and cattle. And instead of considering the loss of gas and oil wells as too great a disadvantage when production dropped, he set about trying to find a way to use the wells.

One of these wells was situated on top of a hill. Cartwright stood beside the abandoned oil well one day and looked out across the land below lying long and flat along side of a railroad. If water could be pumped from the well into a storage tank, he reasoned, it could be released when he wanted it to wind along broad terraces, back and forth, until it reached the flats below to spread over extensive acreage.

Studying the log of the well he learned that it could be plugged at about 600 ft and perforations made in the casing where water sands occurred. This was accomplished without too much trouble. The next problem was to get the water out of the well. A gas well nearby had been losing pressure and was recently abandoned. It was a simple job to connect up with the water well and jet-pump water from it. Gravity did the rest, releasing water to flow over thirsty pastures during dry periods.

Two other oil wells have been converted to water wells and an unfortunate blow-out of a gas well left a huge crater —and an artesian water well. Water from the crater is used to irrigate feed crops and a cattle trail leads thirsty cattle down into the crater to fresh drinking water.

These other wells are not situated so conveniently with respect to gas wells, but engines using distillate from a producing well pump water to the surface.

While most ranchmen prefer to own oil and gas wells, any of them will admit that the next best thing is a good, deep water well.

Cutting up abandoned oil wells into water wells is not just another tall tale from Texas. Cartwright does it. * * *

Water from abandoned oil wells is used to irrigate feed crops. M. O. Walker, Live Oak County commissioner and L. L. Bennett, county agent, look over a feed crop growing on the Cartwright Ranch.

SPRABERRY

CORE DATA DISCUSSIONS

VICTOR B. OGDEN and JACK LOCKE

THE productive Spraberry formation in the trend areas of Midland, Glasscock, Reagan, and Upton counties has the following general characteristics: The clean sand has .002 to 2.5 millidarcies permeability, 6 to 18 per cent porosity, 25 to 45 per cent connate water and 15 to 25 per cent residual oil. The shaly sands have .01 to 0.4 millidarcies permeability, 6 to 12 per cent porosity, 25 to 90 per cent connate water and 0 to 50 per cent residual oil. The controlling influence in the physical properties of the shaly sand is the shale content which may vary, in degree of lamination, from 5 to 50 per cent.

Most of the analyses to date have been performed by the conventional retort type of analysis rather than by whole core analysis. This is because, where the fracture porosity would be of value, the fractures are broken open by the coring process and any reconstruction work would have an indefinite accuracy insomuch as the core fragments would have to be bound together by tape or wire. Consequently, most of the core analyses have been performed to evaluate the matrix. The matrix analyses have been complicated by the presence of a material in the shale laminations that is either carogen or a solid hydrocarbon. This material will not fluoresce under ultraviolet light and will not cut with carbon tetrachloride at normal temperatures, however, at a heat above 700 F it becomes oil. Vacuum distillation at 450 F will not remove this substance. Whether this substance is carogen or a solid hydrocarbon is something that is still not definitely determined, however, we feel that it will not move through the pores of the formation and therefore does not constitute part of the true reservoir of the Spraberry formation.

Fig. 1 is a typical Coregraph in the Spraberry Trend region. Permeability, porosity, and fluid saturations are plotted by the side of a general formation lithology. On the left side of the graph is a "productive porosity" plot indicating the productive zones in the interval cored. "Productive porosity" is the porosity, in rock volume per cent, that was occupied by movable fluid in the formation. Using the residual oil saturations and connate water saturations, the productive zones can be interpreted to be either oil or water productive. In Fig. 1 the productive porosity plot indicates the formation to be productive from the matrix in the intervals 7152 to 7158, 7159 to 7164, 7169 to 7174, 7176 to 7180, 7181 to 7182, and 7186 to 7187 ft. The remainder of the cored interval is nonproductive. The zone 7149 to 7169 ft has two sand stringers, 6 and 5 ft respectively, that are separated by a 1-ft interval of sandy shale. Sandy shale above and below these sand intervals seals them from other productive zones, except through the fracture system. The fluid saturations of these sand bodies indicate oil production and the productive porosity plot shows the residual oil to be the true residual oil of the core samples. The oil saturation in the nonproductive zones is not movable oil and is not actually residual oil. The zone 7169 to 7180 ft consists of sand grading into a laminated shale and sand with the shale constituting roughly 10 per cent of the formation. The productive intervals in this zone, although having only half the storage capacity of the upper sand, is nevertheless effective pay. The productive porosity plot indicates the bulk of the residual oil to be true residual oil and not carogen or a solid hydrocarbon.

The interval 7180 to 7188 ft contains 2 ft of low value pay in the sandy shale. The shale content of this interval averages about 75 per cent. Productive porosity indicates the bulk of the residual oil prior to retorting. From these core analysis figures, movable oil in place per acre can then be calculated. The efficiency of gas expansion production of the volume of oil is still a stumbling block in any evaluation of the matrix. The indications are that gas expansion production is more efficient in the Spraberry than in other formations, possibly because of the regularity of the pore size in the "clean" sand and the small size of the pores. These factors could more efficiently utilize the stored energy of the gas bubbles in moving the oil through the matrix to the nearest fracture flow channel.

Fig. 2 is a logarithmic plot of permeability and productive porosity. The relationship is a straight line which touches the zero productive porosity point at approximately .014 millidarcies, indicating this to be the lower limit of permeability in the clean sand. Deviations occur below 0.1 millidarcies for the laminated sands and shales and vary with the shale content as shown.

All production in the "Trend" area is as dependent upon the fracture system channels as it is upon the matrix for storage. Several examples of the fracture system are presented here. Fig. 3 shows a fracture with a calcite deposit 1/32 in. in thickness along the fracture plane. Fig 5 is an example of multiple fracturing. The horizontal breaks were probably caused by the coring process or during the removal of the core from the core barrel. Fig. 4 is an example of cement occurring in the fractures. This cement was found 14 ft below the casing point and is approximately 1/32 in. in thickness. Cement has been found as far as 90 ft below the casing point. Fig. 6 is a typical Spraberry core showing fracture system throughout a 50-ft core length.

Several interesting problems have been worked out concerning the effects of the fractures upon the production rates. The flow rates of the Spraberry if unfractured have been calculated using normal radial flow equations, 40 ft of permeable sand and optimistic data

The Authors

V. B. Ogden

Jack Locke

Victor B. Ogden was graduated from Oklahoma University with a B.S. in chemical engineering in 1946. For a year after his graduation, he was with the Goodyear Tire and Rubber Company in Los Angeles. In 1948, he joined the Core Laboratories, Inc., and at present is supervisor of the company's West Texas-New Mexico District.

Jack Locke attended Tarleton State and Texas Technological College. He worked for Core Laboratories, Inc., from 1941 to 1946 when he joined Magnolia Petroleum. Locke has worked in the Rotary Engineering Laboratories from 1948, and at present is manager of that department.

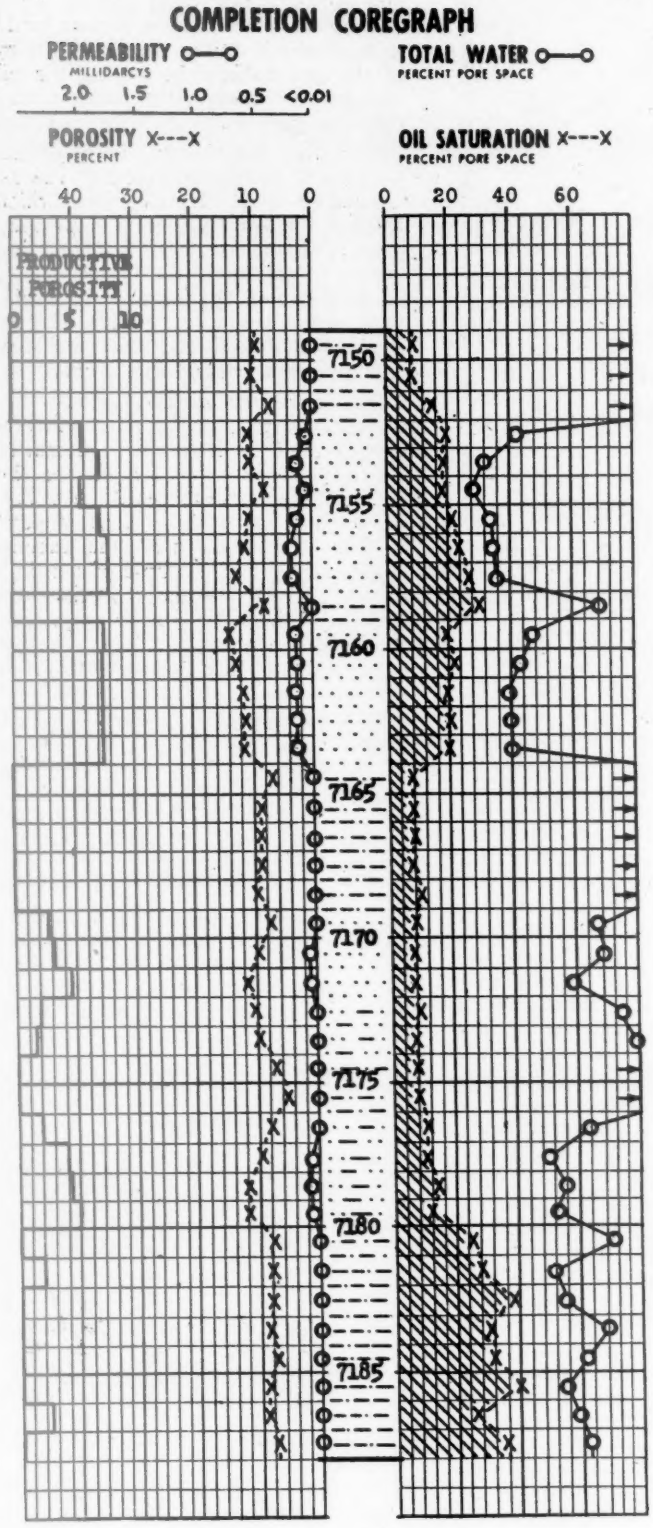

FIG. 1. Typical coregraph in Spraberry Trend.

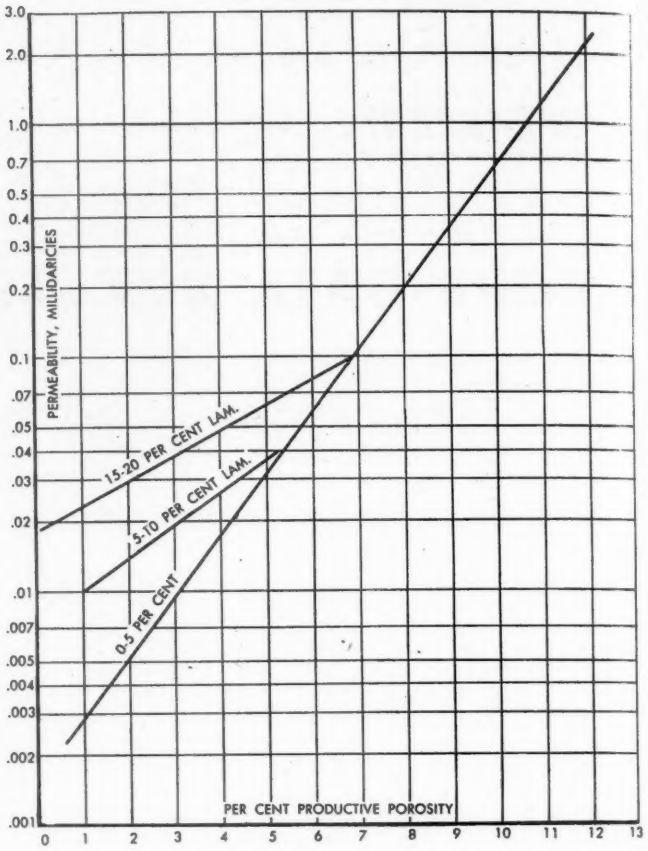

FIG. 2. Logarithmic plot of permeability and productive porosity.

FIG. 4. Example of cement in fractures.

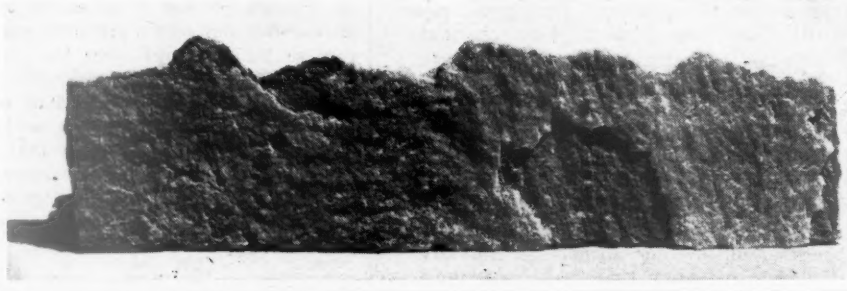

FIG. 3. This shows a fracture with a calcite deposit 1/32 in. in thickness along the fracture plane.

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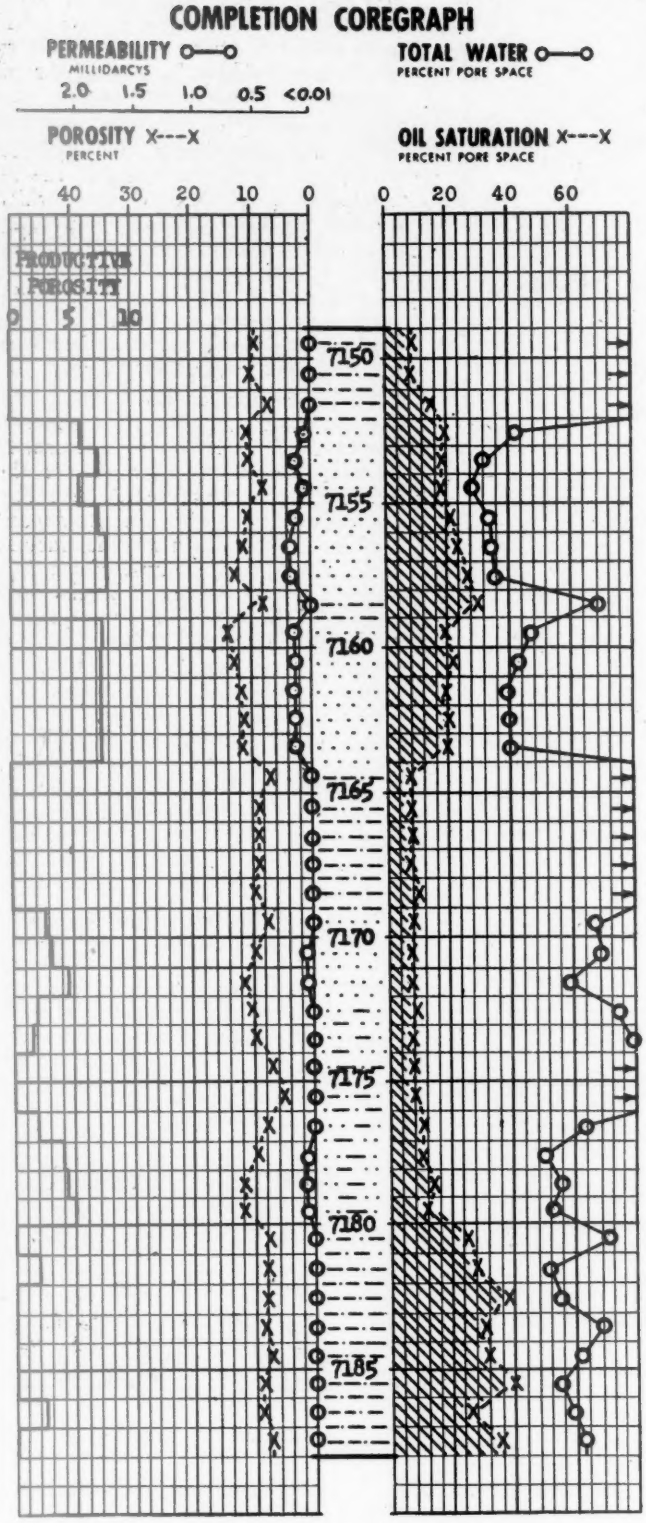

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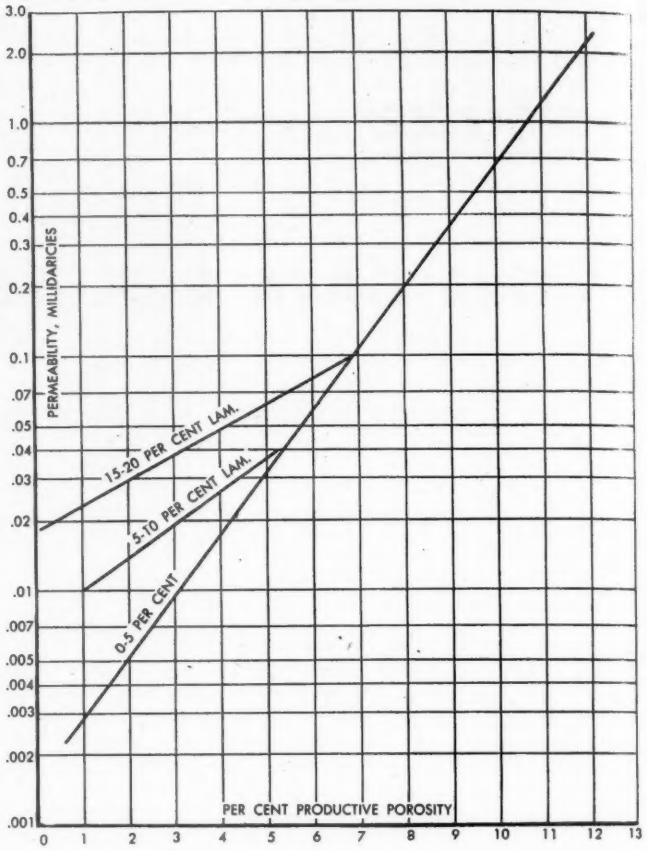

FIG. 2. Logarithmic plot of permeability and productive porosity.

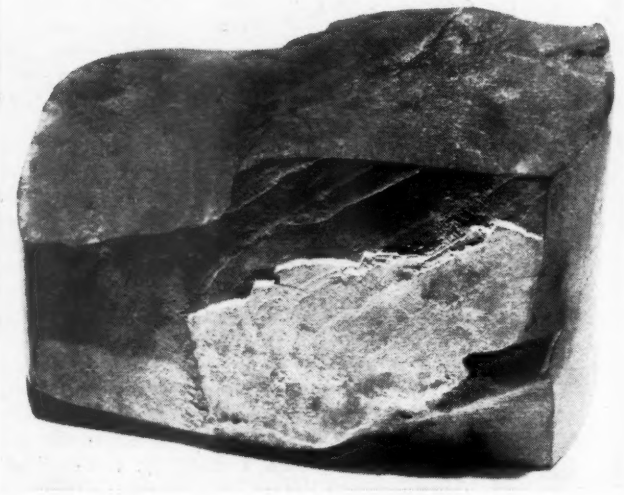

FIG. 4. Example of cement in fractures.

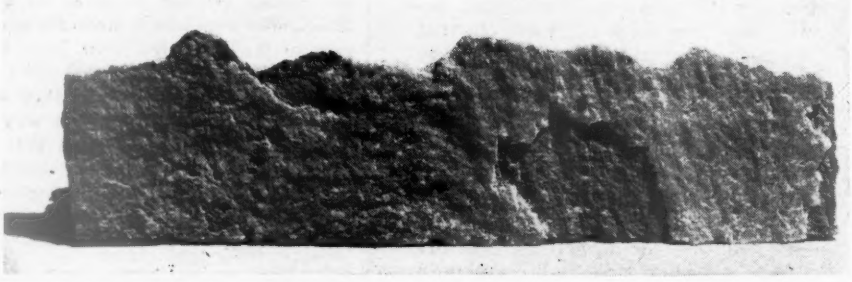

FIG. 3. This shows a fracture with a calcite deposit 1/32 in. in thickness along the fracture plane.

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FIG. 5. Example of multiple fracturing. Horizontal breaks may be caused by coring process or during removal of core from core barrel.

FIG. 6. Looking down on typical Spraberry core showing fracture system throughout a 50-ft core length.

for pressure drawdown and fluid properties. The result of this calculation indicates that under ultimate conditions the sand body in question could not produce greater than 5 to 10 bbl per day. If, however, a fracture is present, extending through the well bore a distance of 100 ft in each direction and is sufficiently open to minimize the pressure drop from the fracture extremity to the well bore, the productive sand face area is increased 128 times for a 12 in. well bore and 192 times for an 8 in. well bore. The above illustrations are extreme examples in that the conditions used in the calculations could not be duplicated in actual practice, however, they serve to illustrate the part the fractures do play in the drainage of the Spraberry reservoir.

* * *

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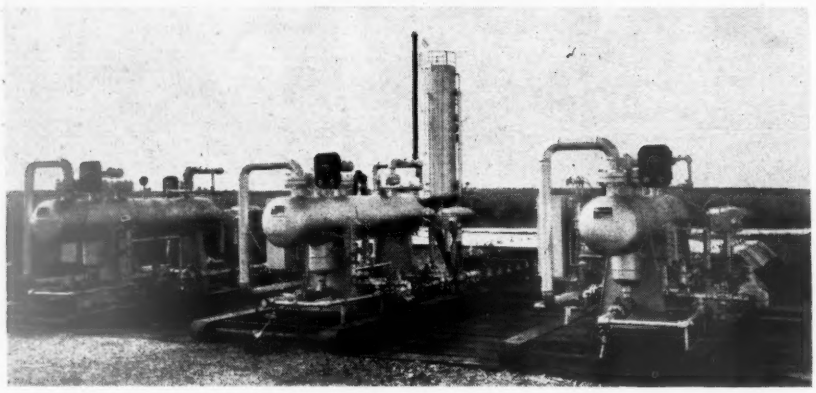

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Made in various sizes and working pressures to fit any operation, Rolo Wellcheckers separate the well fluid into three phases of oil, gas and water, and meter each accurately. This enables operators to check well production daily, and secure accurate tax and royalty records. Installations of this type are approved by regulatory bodies.

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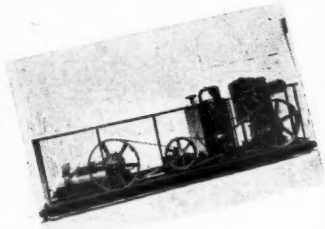

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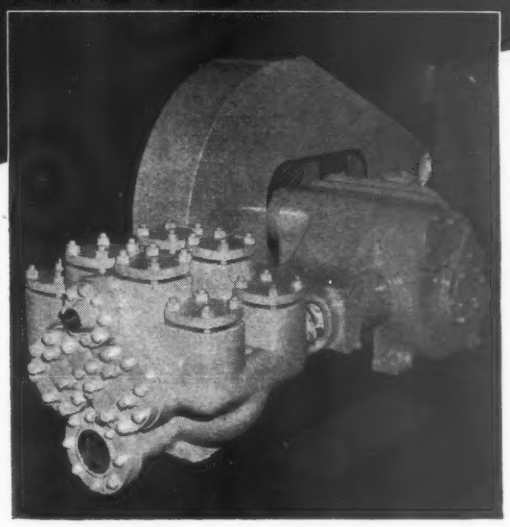

The Bethlehem U-46 is a fine new utility pump that will stay busy on anybody's rig. Frankly, we don't think there's a better unit built for its particular class of work.

The U-46 is a horizontal, duplex, double-acting pump with 4-in. bore and 6-in. stroke. Its primary duty is fresh-water pumping around the rig—getting up the water for mixing, brake-cooling, rig wash-downs, etc. But its fluid end can be equipped to handle oil and mud as well; salt water too, whenever you have a disposal job around a lease.

Speaking of leases, the U-46 is a wonderful performer on gathering work. And there are plenty of other spots where it can pinch-hit on short notice. Mighty handy fellow to have around!

This completely portable unit can be furnished with any type of prime mover—electric motor, gas, gasoline, or diesel engine. Full details and specifications are available through our nearest sales office.

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BETHLEHEM STEEL

Power hook-up for oil well pumping.

Protection in Control and Distribution of Power for Oil Well Pumping†

C. R. OLSON

IN ANY electrical installation, three general types of protection should be provided. First it is necessary to protect both operating and maintenance personnel from electrical shock. In addition to reducing the number of accidents and the resulting lost time, providing a high degree of safety to workmen also helps to improve employer-employee relations. Second, the equipment must be protected against the ravages of nature. This type of damage would include equipment failures caused by lightning as well as rain, sleet, snow, and dirt. And finally the equipment should be protected against excessive damage or loss of production in the event of an electrical fault. An excessive loss of production may easily result if a minor electrical fault causes a large portion of the system to be shut down. Properly, only the faulty unit should be shut down and removed from the rest of the system.

The modern electrical oil well pumping control and distribution system provides these three general types of protection, and this paper will attempt to show just how this is accomplished. Many design features of such a system are based on some economic protective means and consequently its importance is readily seen. Even the selection of wire size is partly based on preventing excess power loss, and low voltage with the resulting possible motor burnout and failure to start.

Lightning arresters, circuit breakers, motor overload relays, weather protection, grounding—this is a partial list of the protective devices and means used today in a modern electrical oil well pumping system. Each plays one or more

†Presented at the Petroleum Electric Power Association, November 19-20, 1951, Houston, Texas.

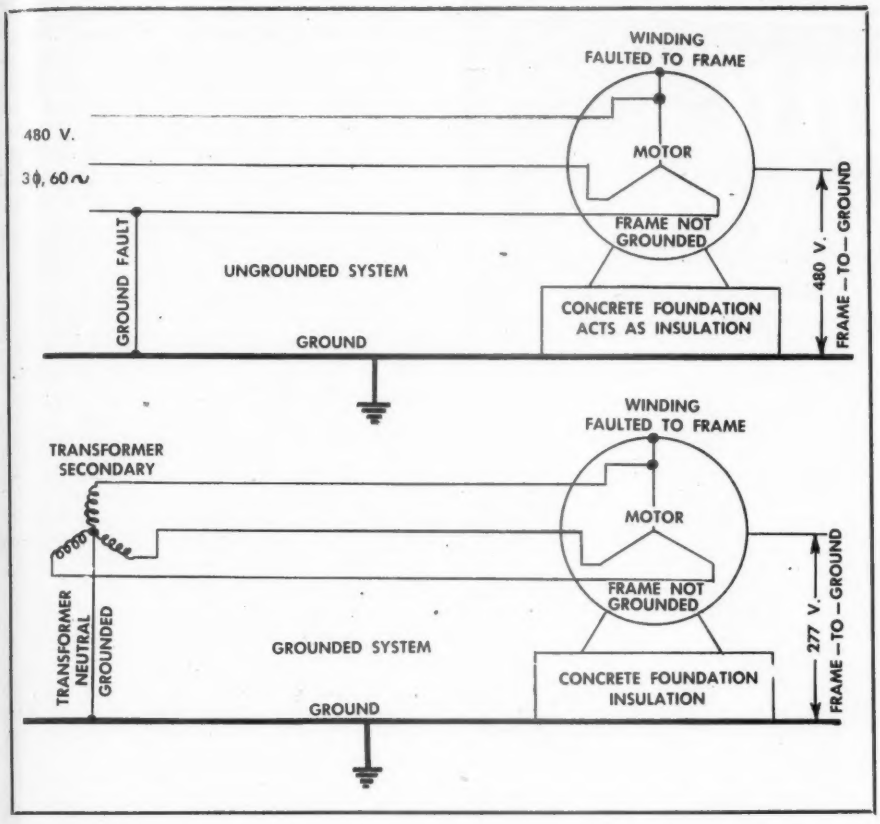

FIG. 1. Dangerous voltages can appear on the ungrounded frames of pumping motors with either a grounded or ungrounded electrical supply system.

parts in protecting men, equipment, and production.

Protection of Personnel

The safety of the men who install, operate, and maintain the pumping field is, or at least should be, of prime importance. Where electrical equipment is involved, this is best accomplished by making potentially live parts relatively inaccessible and by insuring that exposed parts (such as control cases and motor frames) never become "hot" electrically. An apparently harmless item such as the controller case can prove lethal under certain, unfortunately not too uncommon, conditions. All exposed parts should be well grounded to prevent dangerous voltages from appearing on this equipment. Fig. 1 illustrates how such voltages can appear for both ungrounded and grounded electrical distribution systems if this precaution has not been taken. Where all exposed parts are well grounded, and thereby bonded together, dangerous voltages cannot exist between the apparatus and ground or between various pieces of equipment. The well casing, or gathering pipe line connected to the well casing serves as an excellent ground, if company regulations do not prohibit such a connection.

Enclosing metal cases for controllers makes the normally live parts of this equipment inaccessible to unauthorized personnel. As seen in Fig. 2, the entire controller, including the pushbuttons, etc., are enclosed when the cover is shut. Incidentally it may be padlocked in the closed position. When this outer cover is opened for normal operating procedure, as in Fig. 3, the various controls such as pushbuttons, circuit breaker operating handle, and timer are available, but all the live parts are enclosed behind the dead front operating panel. In order to change overloads, or perform maintenance on the contactor or other equipment mounted behind the dead front panel, the circuit breaker must be tripped before the inner panel can be opened, thereby killing all of the normally live parts except the incoming line terminal and the lightning arrester. The control unit with the inner panel can be opened, thereby killing all of the normally live parts except the incoming line terminal and the lightning arrester. The control unit with the inner panel open is shown in Fig. 4.

Thus, when good grounding practices and dead front control apparatus are used, a high degree of safety to personnel is insured.

There is not too much controversy on these safety measures, but in the last few years there has been considerable discussion in some industries on the

FIG. 2. Oil well pumping control unit with closed cover.

FIG. 3. Oil well pumping control unit with outer cover latched open for normal operational adjustments.

FIG. 4. Oil well pumping control unit with inner panel exposing parts for maintenance. Inner and door panels held open by cover bracket.

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relative safety of grounded and ungrounded distribution systems. Some feel that the ungrounded system is safer as normally there is no electrical potential between ground and the hot leads, thus making it safer for maintenance men to work "hot" where this is necessary. A single ground on such a system, however, will not trip the breaker or blow a fuse and will place the two other phase leads at full line-to-line voltage above ground. Because of this danger, others feel that the grounded system is safer. With a grounded system, all three phase conductors are always at line-to-neutral voltage above ground. The electricians, appreciating this, treat the system with more respect, and do not lull themselves into a false sense of security. In the event that they do get themselves between a line and ground, the maximum voltage is the line-to-ground voltage of the system (277 volts for a 480 system) as compared to the possible full line-to-line voltage of 480 volts on an ungrounded system with a single ground fault. See Fig. 1.

Another danger is caused by the automatic control equipment. Automatic, time-clock operated pumping units start unexpectedly without the presence of any operating personnel. This could be a hazard to maintenance personnel or the casual observer. Such possible hazard is easily avoided by warning signs and common sense.

Protection Against Weather

The electrical equipment, as well as the personnel must be protected as mentioned previously. It is rather obvious that the various quirks of mother nature must be taken into account in designing and applying the apparatus for use in an outdoor installation such as an oil well pumping field.

Weatherproof enclosures are used for control apparatus to keep out snow, sleet, rain, and heavy concentrations of dirt and dust. Figs. 2 and 3 show the louvered ventilating openings, labyrinth type door closures, and overhanging roof that are used for this purpose. These enclosures have special finishes to resist the corrosive effects of various atmospheric conditions. Likewise, for outdoor service insulators and transformer and capacitor bushings are larger, having long leakage paths to provide adequate insulation when wet with rain or covered with ice or snow.

Lightning Protection

Lightning, one of nature's dramatic excesses, must also be taken into account and its potential damage prevented. Starting at the distribution transformer, lightning arresters should be applied between the high voltage line and the transformer tank as shown in Fig. 5. The transformer tank is either solidly grounded or a discharge gap is placed between the tank and the ground wire. Then any surges coming in over the high voltage line will go to ground rather than arc over to the low voltage windings. This avoids the

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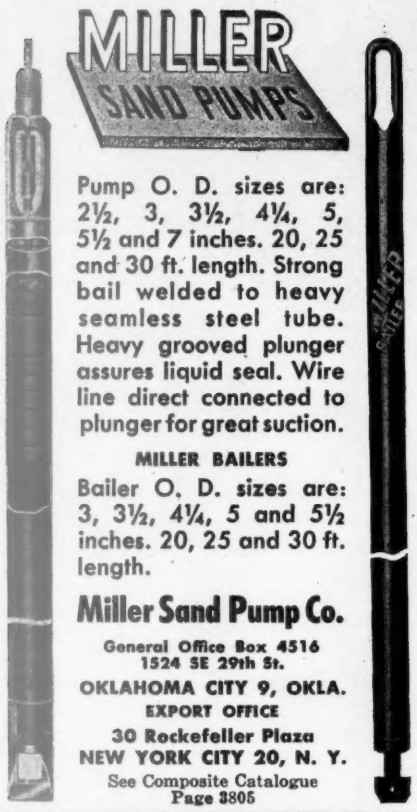

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The Author

Carl R. Olson was graduated from Carnegie Institute of Technology in 1943 and went to work for the Aluminum Company of America as a plant engineer. Later he served in the Navy as an aviation electronics officer. Since his release from the Navy in 1946 he has been employed by the Westinghouse Electric Corporation working on the application of electrical equipment in the petroleum and chemical industries.

possibility of having the full high line voltage appear on the motor windings and low voltage control. Usually the distribution transformers are also equipped with a discharge gap between the low voltage bushing and the tank to limit the voltage that can appear on the secondary winding low voltage lines.

The additional protection equipment required for the low voltage (480 volt) system normally consists simply of a lightning arrester in the control cabinet of the motor. A commonly used type of arrester for this purpose includes a number of parallel or multiple gaps in series with a valve element. The gap limits the voltage rise and the valve element extinguishes the arc after the surge has passed, thus preventing the flow of power follow current. Where lightning conditions are particularly severe and motor winding failures persist with normal protection, capacitors are sometimes connected in parallel with the lightning arrester. Such capacitors result in a less steep wave front of any surge voltage that may enter the motor and thereby reduce appreciably the hazard of turn-to-turn motor winding failure. Indoor type capacitors mounted in the control cabinet are used for this purpose.

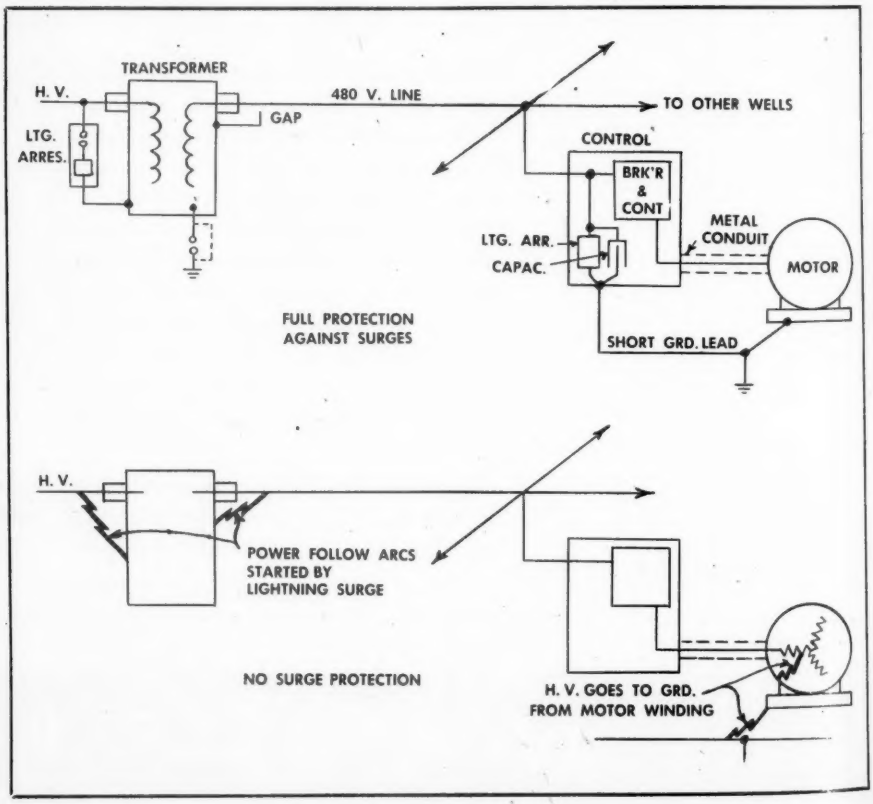
From Fig. 5 it can be seen that solid grounding of the motor frame and controller case mentioned above is also necessary for good lightning protection. In addition to providing a convenient path for surge currents, the grounded metal cage consisting of the control unit case, conduit for the motor leads, and the motor frame serves as an equipotential shield, thus limiting the voltage between the case and the conducting parts to substantially the voltage across the arrester.

Electrical Fault Protection

The third type of protection involves the prevention of damage by overloads or electrical faults.

Short Circuits. Short circuits must be removed from the source of power promptly to prevent serious damage to the equipment. If not taken off immediately a short in the motor could cause destruction of the motor, welding or burning of the contactor contacts, burnout of the starter overload relays, and burning of the leads to the motor. Circuit breakers or fuses in the individual oil well pumping control cabinets are used as protection against this damage. These devices then must have sufficient

FIG. 5. Surge protective equipment is good insurance against lightning damage.



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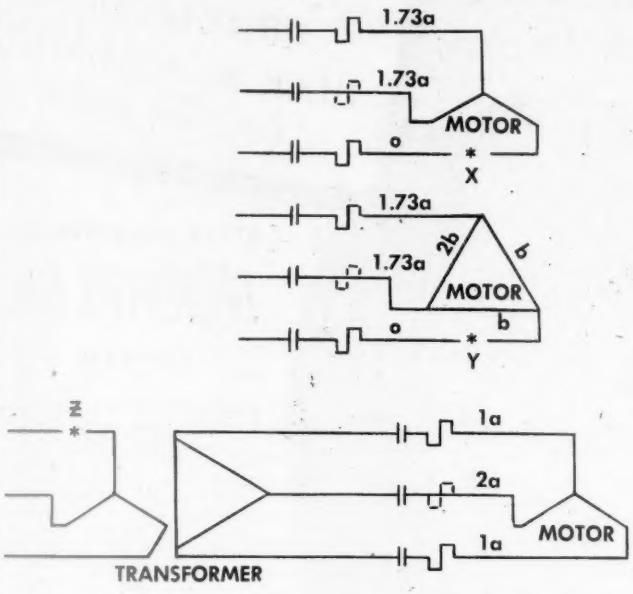

Single Phase Condition	Percent Load	Max. Motor Current—Percent of Full Load	Heater Current Percent of Rating Two Overloads	Heater Current Percent of Rating Three Overloads	Trip
No	100	100	80	80	No
X	100	173	138	138	Yes
X	72	124	99	99	No
Y	100	200	138	138	Yes
Y	72	143	99	99	No
Z	100	173	100	200	With 3 OL's Only

FIG. 6. Various single phase conditions and the resulting motor winding and overload relay currents.

interrupting capacity to clear any fault to which they may be subjected. Consequently, a certain amount of care should be exercised in applying breakers or fuses to make sure that they will be capable of interrupting the maximum fault current that can occur. Usually, however, this does not present a problem in oil well pumping fields as the fault currents are relatively low due to small transformer size and long transmission lines.

Circuit breakers have numerous advantages over fuses for short circuit protection as they do not require replacement, there are no exposed conducting parts, there is a visible indication of any tripping operation, and as all three poles are a mechanical unit and therefore must trip simultaneously breakers cannot cause a single phase condition.

Single Phase. It is desirable to protect motors against single phase as motors running under this condition will draw more than normal current and tend to overheat or burn out. Single phase can be caused by an open phase in the motor winding, an open circuit anywhere in one line on the secondary side of the transformer (such as one blown fuse in the controller), or a blown fuse or open line in the primary side of transformer. Fig. 6 illustrates various single phase conditions, and the accompanying table shows the winding and overload currents in per cent of their *rated* values. This is shown for cases of both two and three overloads. It can be seen that three overloads will give better protection against single phase conditions than will two. The oil well pumping control unit illustrated in Fig. 2 is available with either two or three overload relays. An expensive example of what can happen when single phase protection is omitted occurred recently on an oil well pumping lease. The 2400-volt incoming line went single phase with the resut that 57 motors burned out. Three overload relays would have prevented this loss very nicely.

A number of fields have operated successfuly for many years without any serious trouble from single phasing. There has been enough trouble, however, from this cause that serious consideration should be given to the use of three overload relays. This is particularly true where the supply system is long and not well protected, and where wide well spacing is used, thus necessitating an extensive high voltage distribution system.

Undervoltage Protection and Time Delay. The interruption of power due to the opening of main disconnects, fuses, breakers, or other reason, will cause all affected linestarter contactors to open. If low-voltage protection has been provided in the control, each motor must be started individually by manually resetting the low-voltage protection relay or by depressing the start button.

Such attention for restarting is desirable in most cases when the control is manual. When time clock control is used, however, it is sometimes permissible and desirable that the equipment restart automatically when power is reapplied. This would mean simultaneous starting of all motors whose time switches called for pumping, with consequent high current demand on the power lines and station. Such demand would be particularly undesirable for a lease generating station, as the capacity of such a station is relatively limited.

A time delay relay is available for providing starting of the motors at preset intervals when power is reapplied. This is an electropneumatic-type device with a pneumatic time-delay element. The range of operation of the relay permits at least 20 different settings that would provide for starting as many motors at separate starting times.

This complete relay consists of a magnetic element and a pneumatic element. It serves as an undervoltage relay with only the magnet element supplied and may be converted to the complete time-delay relay by adding the pneumatic element. Where automatic timeclock operation without time-delay restarting is used, it is necessary to provide an undervoltage relay. Without this protection all units scheduled for pumping by their timeclocks would attempt to restart simultaneously when power service is resumed after an outage.

Phase-to-Ground Faults. Grounding, as affecting personnel safety and lightning protection, has been discussed, but there is still another aspect of this subject to be covered. Single phase-to-ground faults can be a nuisance in that too frequently they are not detected until the second such fault occurs on another phase. If these grounds are remote from each other on the distribution system but still relatively low in impedance, one or more breakers may open, making the faults difficult to locate. If the ground impedance is high, however, there may not be sufficient current to cause breaker tripping, but considerable equipment or cable damage can result from the low current arcs.

If the best isolation of these line-to-ground faults is desired and if low current burning arcs are to be prevented as much as possible, the grounded wye distribution system should be used. For this system, the secondaries of the distribution transformers throughout the field are wye connected and the neutral of this wye solidly grounded. Then a ground on a feeder, or in the motor or control will cause an immediate breaker trip, thus giving immediate isolation to the fault. Much more positive tripping

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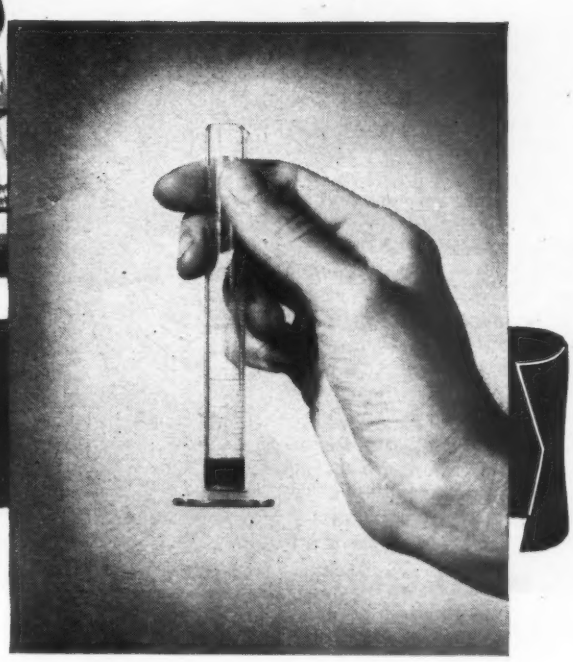

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action is obtained under ground fault conditions with this system than with an ungrounded system as only one fault impedance is involved, and because the transformer's grounded neutral and the fault are relatively close.

There are several disadvantages to this system as applied to oil well pumping, however. The transformers are a little more expensive, some production may be lost due to inopportune shutdowns, and it is not possible to operate with only two of three transformers in the bank. Frequently transformer banks are operated open delta, the third unit being added when more pumping units increase the load. The choice of a grounded wye or ungrounded delta system cannot be set down as a hard and fast rule. There are too many factors to be considered and consequently the system selection is based on the relative weight given these factors as based on personal opinion.

Overload Protection

Overload relays have been mentioned, but so far nothing has been said regarding the types available. The most common type is a thermal device in which an electric heater in series with the motor leads heats a bimetal. The temperature rises on overload to a point where the bimetal acts to open the contactor coil circuit, thus dropping out the contactor and removing the motor from the line. This type of overload relay is quite satisfactory for a large percentage of squirrel cage motor applications. There are, however, several conditions under which these standard thermal overload relays are not entirely satisfactory. One such condition can exist in the oil fields or in any outdoor installation. It would appear, as both the motor and the control unit are subject to the same ambient temperature conditions, that the thermal overload relays would give good protection. However, the ambient temperature of the motor and control may be far from equal. The motor ambient will be the temperature of the surrounding air since it is fan ventilated. The ambient temperature of the overload relay, however, is the temperature of the air inside the control cabinet, which may be considerably higher as the result of a hot summer sun. If the motors are to be kept running up to their capacity, it is often necessary to use oversize heaters in the overload relay to compensate for this condition. Then on cloudy days, or during the winter with a cold wind blowing around the controller, the motor is not as well protected.

One answer to this would be to use an ambient temperature compensated overload relay that responds to motor amperes rather than total temperature. It is appreciated that this does not permit variations in motor loading with ambient temperature changes, however, this is not a serious problem. The major objection to temperature compensated devices of this type is their cost, it being several times that of standard overloads, and consequently this type is not considered unless a very high degree of motor protection is desired.

Another type of overload device that has proved valuable in a number of cases is the "Thermoguard," a bimetal thermal device that is applied directly to the motor end turns. This type of device responds principally to total motor winding temperature and consequently it can be a material aid in protecting the motor against such things as frequently repeated overloads, high ambient temperature, abnormal voltages, ventilation failure, and phase failure. Its use does not, however, eliminate the need for the usual overload or undervoltage protective device as it does not afford adequate protection against short time, excessive overloads. It is difficult to apply "Thermoguards" properly in the field, and because of this, it is recommended that they be included on the motor as shipped from the factory.

Conclusion

The electrical industry has built into their modern oil well pumping equipment elements to protect personnel, equipment, and production against these hazards. Because of this, the user is not required to give consideration and engineering time to many of these details, however, the equipment must be properly applied and installed if it is to do an effective job in oil well pumping. * *

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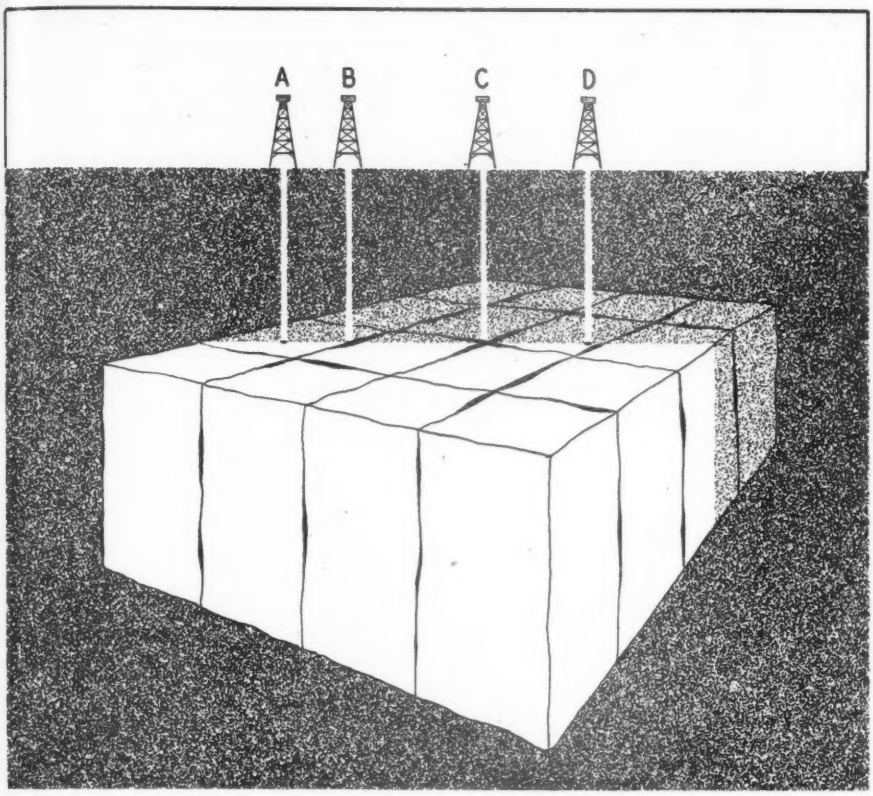


FIG. 1. The productivity of Spraberry wells depends largely on their position with relation to naturally occurring fractures in the formation. The more extensive the fracture system communicating with the well bore, the greater will be the effective drainage area of the well.

Stratafrac Completions

Fracturing in greater Spraberry has brought good results in increasing oil production

JACK M. MOORE* AND RAY S. OUSTERHOUT*

Abstract

The productivity of wells completed in the Spraberry Trend depends largely on the extent of formation fractures communicating with the well-bore. The Stratafrac method of well stimulation consists of forcing into the formation a viscous kerosine-acid gel, containing sand. This serves to open up and extend fractures along natural lines of weakness, as well as to prop open the fractures, affording unblocked drainage of oil into the well. In addition, the acid constituent of the gel serves to dissolve and remove cement, calcareous material, silicates, clays, and drilling materials from the fractures, that might otherwise interfere with full production of the well. This method has proved to be highly successful in the greater Spraberry, not only on original completions but also in retreatment of non-producing wells that otherwise might be abandoned.

*Howell Incorporated. Midland, Texas

THE unique properties of the Spraberry sand present unusual completion problems to the well operator. Such a formation, consisting of sand and shale, with porosities varying between 5 and 20 per cent and permeabilities frequently less than 1 md., normally would be considered non-productive. The highly developed system of vertical fractures occurring naturally in the Spraberry sands, however, form gathering points for the oil. Wells drilled into these fractures produce at rates completely inconsistent with the low permeability of the matrix itself. As a result, the production of any given well appears to depend upon the number and extent of the fractures with which it communicates, and the ease with which the oil can drain through these fractures into the well bore.

This peculiarity in the Spraberry often leads to the seeming paradox of a marginal producer in an area completely surrounded by good production. One possible cause for this situation can be visualized as illustrated in Fig. 1. Here four, purely hypothetical, well conditions are presented. Well A, penetrates into a section that is not fractured and, because of the extremely low permeability of the formation matrix, is, for all practical purposes, a dry hole. Well B, completed in a vertical fracture, has a large effective drainage area and is a fairly good producer. Well C, completed at the intersection of transverse vertical fractures, has the increased effective drainage of both fractures, together with any parallel fractures they might intersect. Accordingly, this well is an exceptionally good producer. Well D, although it is drilled close to or through a fractured section, does not actually cut through a fracture. As a result, comparable to Well C, it gives little if any production.

Analyzing this situation, it appears that Well D could be readily converted into a producing well, if the adjacent fracture could be connected to the well bore. Accordingly, present day completion methods in the Spraberry trend are designed to accomplish this end as much as possible. Where such methods fail it is assumed that the bore hole was too distant to be connected with the natural fractures of the reservoir, as in Well C.

Another problem in Spraberry drilling and completion is that of contamination or plugging of the fractures. This problem deserves prime consideration as the productivity of the well depends largely on the unimpeded flow of oil through the fractures and into the well bore. Early in the life of the field it became apparent that specialized drilling methods would be necessary, as conventional drilling muds and lost circulation materials blocked later production through the natural fractures. As a result, oil-base muds or cable-tool drilling were employed as soon as the Spraberry sand was reached. It became common practice in open hole completions to cement casing seats as much as 50 ft above the top of the Spraberry, to prevent the cement from channeling downward into the pay. As the fractures extend upward a considerable distance into the overlying shale, even this precaution does not always prevent by-passing and downward movement of slurry during the cementing operation. In some cases, fractured cores containing cement have been recovered as deep at 90 ft below the casing seat.

A number of different completion methods have been employed to meet the specific problems of the Spraberry formation. One highly successful technique, known in the field as Stratafrac, has been that which employs the recently developed material, Jel-X 500. Wells brought in by this method have shown an excellent record of initial potential and continuing operation.

EXCLUSIVE

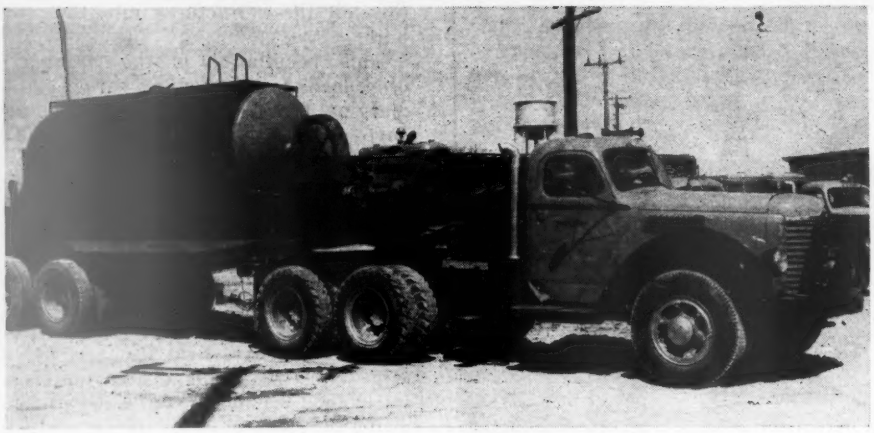


FIG. 2. Jel-X 500, used in Stratafrac treatments, consists of a kerosene-acid gel containing suspended sand. This mixture is transported to the job in specially designed tank trucks, such as is shown above.

Completions Using Stratafrac

A Stratafrac treatment consists of squeezing Jel-X 500 into the producing formation. Jel-X 500 is a smooth, pumpable kerosine-acid gel. To this gel is added a special round-grained sand, approximately 40 mesh, usually in a proportion of three-quarters of a pound of sand per gallon of gel. This proportion may be reduced or increased to meet special well requirements. The Jel-X 500 has sufficient body to carry the sand in suspension, eliminating the need of mixing at the well. Fig. 2 is a photograph of a specially designed unit employed in the preparation and transporting of Jel-X 500.

An important advantage of Jel-X 500 is that no gel-breaker solution is required in conjunction with its use. Once it has been pumped into the formation, it thins of its own accord, returning readily to the well bore as a thin, easy-flowing liquid. Jel-X 500 contains various chemical agents that promote increased dissolving power for calcareous material, cement, petroleum residues, silicates, and various clays or drilling mud residues that may be present in the fractures. Special conditioning agents assure the return of the spent acid to the well bore, together with the kerosine, following the treatment.

The Stratafrac method of well completion accomplishes the following objectives:

(a) Extending natural fractures in the formation and propping them open with a highly permeable medium to permit the uninterrupted drainage of oil into the well bore.

(b) Dissolving and cleaning out material within the natural formation fractures, or adhering to the walls of the fractures.

When a Spraberry well is completed using Stratafrac, the Jel-X 500 is injected into, and will follow, the naturally occurring fractures. Where such fractures are limited in extent, a sufficient pressure build-up may be obtained to extend them along the natural line of weakness. It is also possible to extend such fractures to a point where they may intersect other fractures in the formation, thus adding materially to the effective drainage area of the well.

In addition, the Jel-X 500 serves to clear away obstructing material in the natural fractures. When the Jel-X 500 thins out at the end of the treatment, the sand is deposited in such manner that the fractures remain permanently open, assuring free passage of the oil into the well bore.

The problem of obstructed fractures undoubtedly is responsible for the blocking of oil flow in a number of non-producing Spraberry wells today. Fractured Spraberry cores have been recovered in which the fractures were completely filled with cement, forced there during earlier operations. Other cores show extensive deposits of calcite, or other crystalline material, lining the walls of the fractures. The photographs in Figs 3a, 3b, and 3c illustrate these conditions.

In some instances, large quantities of mud or lost circulation materials have been encountered in the fractures, having channeled down through a series of connected fractures, from drilling operations in the shale above. It is here that the solvent properties of the Jel-X 500 mixture prove advantageous. It is designed to dissolve and remove silts, clays, and drilling muds from the fractures, as well as cement or mineral deposits.

X-ray analysis of a sample of material filling the fracture of a Spraberry core showed the following composition:

Alpha quartz—SiO_2	40 per cent
Salt—NaCl	30 per cent
Amorphous silicates	30 per cent

Other materials that have been identified in Spraberry fractures are barium sulfate ($BaSO_4$) and petroleum residues. As a result of removing these materials, many wells that have shown little or no indication of being producers, have been opened up by means of the Stratafrac process to give good potentials. Data on typical Stratafrac treatments conducted during the past four months are shown in Table 1.

Stratafrac Treating Procedure

A principal advantage of the Stratafrac method of well completion lies in its simplicity. There is no need for bulky or unusual equipment at the well. Jel-X 500 is premixed and hauled to the job in specially designed pump trucks. At the job site the entire treating procedure is no more complicated than that involved in acidizing beneath a packer.

The well first is filled with oil and the packer is set. Most treatments of this

FIG. 3a

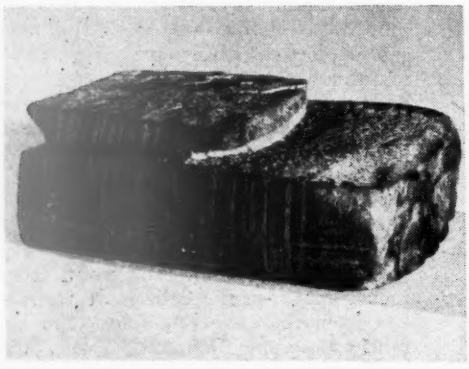


FIG. 3b

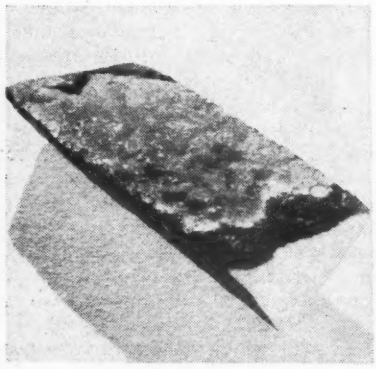


FIG. 3c

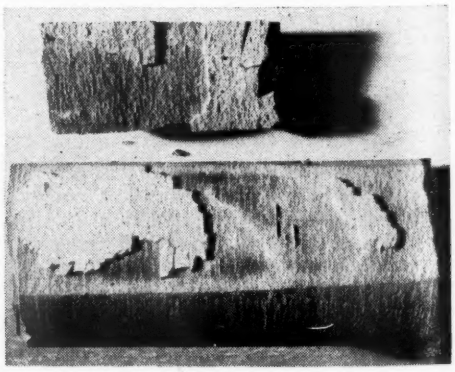
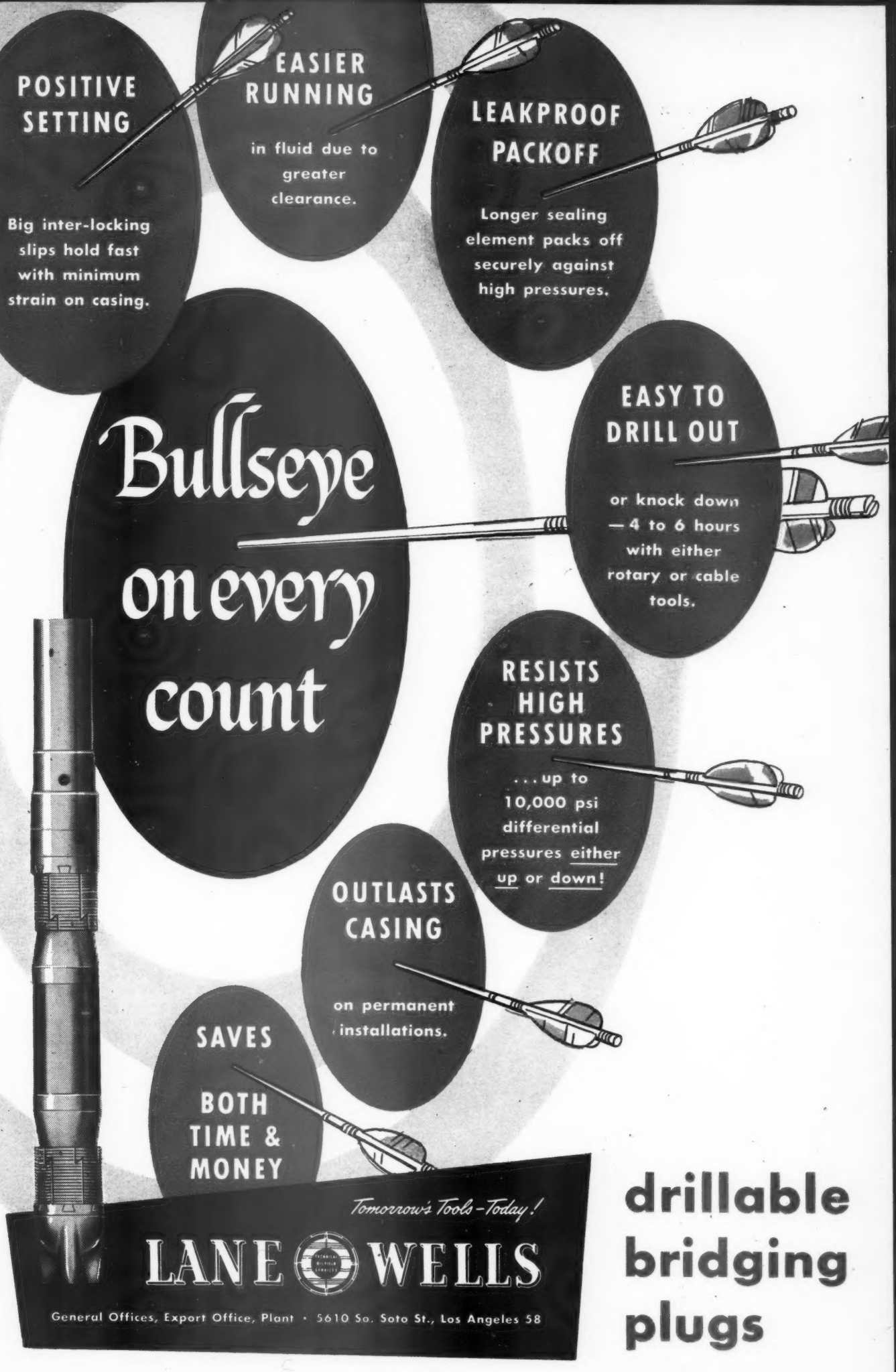


FIG. 3. Cores taken from the Spraberry formation showing fractures blocked by (a) cement, (b) calcite deposits, (c) cement. Such materials are dissolved by the Jel-X 500 during a Stratafrac treatment, leaving the fractures open for maximum production.


POSITIVE SETTING
Big inter-locking slips hold fast with minimum strain on casing.
EASIER RUNNING
in fluid due to greater clearance.
LEAKPROOF PACKOFF
Longer sealing element packs off securely against high pressures.
Bullseye on every count
EASY TO DRILL OUT
or knock down — 4 to 6 hours with either rotary or cable tools.
RESISTS HIGH PRESSURES
... up to 10,000 psi differential pressures either up or down!
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type are conducted using a hook-wall type packer. Occasionally, however, a straddle packer is employed, or the well is treated down the casing with no packer at all, depending upon individual well conditions.

Truck-mounted high-pressure pumping equipment is connected directly into the well head. The Jel-X 500, containing the suspended sand, then is pumped into the formation. This is followed by an oil over-flush to carry the sand back into the formation and away from the well-bore. If necessary during the treating procedure, oil is pumped down the annular space to equalize the forces acting across the packer. Following treatment a few wells have kicked off without assistance; however, most wells of this type have required a few pulls of the swab.

Considerable attention has been given to injection pressures and rates during Stratafrac treatments. No apparent correlation, however, has been found between such figures and the final results obtained. The amount of pressure developed will depend largely on the extent of the fractures communicating with the open hole. To date, the maximum surface pressure encountered on a Stratafrac treatment has been 3500 psi. The best result following treatment have been reported from a well where the maximum surface pressure was only 800 psi, however, at an injection rate of 3 bbl per minute. This would seem to indicate that a high degree of fracturing existed at the well-bore on this particular job. Undoubtedly, whatever the degree of fracturing that may be present in any given instance, the extent to which the fractures are cleaned out and opened up is the determining factor in the success of the treatment.

TABLE 1. Field results of Stratafrac treatments.

Well	Area	Jel-X 500 (Gallonage)	Type packer	Maximum injection pressure (psi)	Average injection rate (B/M)	Results of treatment (Potential bbl/day)	Choke (in.)	Tubing pressure (psi)
1	Midkiff	4,000	H-W[1]	1350	2.2	215		
2	Driver	15,000	H-W	2600	2.4	795		
3	Tex-Harvey	15,000	H-W	2450	2.2	661	1/2	250
4	Benedum	3,000	H-W	2600	3.6	234		
5	Weiner-Floyd	3,000	H-W	2800	5.0	240	1/2	80
6	Tex-Harvey	1,500	H-W	2300	2.5	289		
7	Driver	1,500	H-W	2000	3.5	396		
8	Driver	1,500	H-W	800	3.0	816		
9	Midkiff	4,000	H-W	1650	4.5	606		
10	Tex-Harvey	4,500	H-W	3200	5.4	193		
11	Tex-Harvey	4,500	H-W	900	8.5	569		
12	Tex-Harvey	4,000	Strad[2]	2350	6.0	423		
13	Benedum	2,500	H-W	2800	3.0	168		
14	Pembrook	4,500	Strad	2900	4.4	135		
15	Tex-Harvey	4,500	Strad	1200	4.0	334	31/64	100
16	Driver	6,000	H-W	2200	3.5	330	1/2	
17	Driver	4,000	H-W	2900	4.5	247		
18	Midkiff	4,500	H-W	2900	5.0	330		
19	Tex-Harvey	4,500	H-W	3500	5.9	239	24/64	180
20	Benedum	4,000	H-W	2800	3.8	328	24/64	300
21	Tex-Harvey	4,500	H-W	2300	5.0	273	1/2	110
22	N. Pembrook	4,500	H-W	2800	4.5	358	1/2	100
23	Weiner-Floyd	4,000	H-W	2700	5.5	180	20/64	60
24	Benedum	1,500	H-W	2700	4.0	80		
25	N. Pembrook	4,500	H-W	2500	4.5	127		
26	Midkiff	4,000	H-W	2000	4.0	310		
27	N. Pembrook	3,000	H-W	2800	5.0	211		
28	Midkiff	4,500	H-W	2600	4.5	265		
29	Tex-Harvey	4,500	None	1600	5.3	221		
30	Tex-Harvey	6,000	H-W	2900	5.8	335		
31	Benedum	3,000	H-W	2200	5.5	245		
32	N. Pembrook	4,000	H-W	2700	4.5	130	1/4	
33	N. Pembrook	4,500	Strad	2000	4.0	78		
34	Pembrook	4,500	Strad	2500	4.0	97	20/64	65
35	Pembrook	4,500	Strad	2500	3.0	75		
36	N. Pembrook	4,500	Strad	2500	4.0	207	1/2	115
37	N. Pembrook	6,000	Strad	2900	3.5	234	1/2	75
38	Germania	4,500	H-W	2300	4.8	127		
39	Weiner-Floyd	3,000	H-W	2000	4.3	136	3/8	
40	Driver	6,000	Strad	2000	3.0	Flowing 240 after 20 days		
41	Driver	1,500	H-W	2000	5.2	493	1/2	160
42	Driver	1,500	H-W	1500	3.5	552	1/2	150
43	Driver	1,500	H-W	1000	3.5	720	1/2	150
44	Weiner-Floyd	3,000	H-W	2200	7.0	251		
45	Weiner-Floyd	4,500	H-W	1750	6.0	462	1/2	180
46	Weiner-Floyd	8,000	Strad	2700	2.5	220	20/64	100
47	N. Pembrook	1,500	H-W	1900	5.0	134	48/64	60
48	Driver	1,500	H-W	1500	5.0	571	1/2	200
49	Driver	4,500	H-W	2500	4.7	480	1/2	175
50	Driver	2,500	H-W	2700	5.3	239	24/64	290
51	Midkiff	4,000	H-W	2000	5.8	360	3/4	
52	N. Pembrook	1,500	H-W	2100	4.5	394	1/2	120
53	Germania	4,500	H-W	3500	5.5	170	24/64	125
54	Driver	1,500	H-W	1800	6.0	505	24/64	250
55	Germania	4,500	H-W	2600	4.0	454	24/64	190
56	N. Pembrook	4,500	Strad	2700	6.0	128	20/64	90
57	Pembrook	1,500	H-W	2300	4.3	281	24/64	80
58	Pembrook	1,500	H-W	1650	3.0	133	48/64	60
59	N. Pembrook	1,500	H-W	2100	6.0	329	1/2	70
60	Driver	4,500	H-W	2700	4.0	173	1/2	80
61	Driver	6,000	H-W	2700	4.3	190	1/2	60
62	Midkiff	4,000	H-W	2800	5.0	349	2	40
63	N. Pembrook	1,500	H-W	2650	6.0	387	1/2	150
64	Driver	3,000	H-W	2200	3.5	480	16/64	110
65	Tex-Harvey	4,500	H-W	3500	5.5	128	24/64	200
66	Driver	1,500	H-W	1500	4.6	356	24/64	200
67	Weiner-Floyd	4,500	H-W	2100	3.5	382	1/2	200
68	Pembrook	1,500	H-W	1550	5.0	140	1/2	75
69	N. Pembrook	1,500	H-W	2450	5.0	130	24/64	70
70	Weiner-Floyd	4,000	H-W	2850	4.0	Flowing 112 BPD and 38 BWPD	1/2"	
71	Driver	3,000	H-W	2200	6.0	137 BOPD thru 20/64 chok		50
72	Tex-Harvey	4,500	H-W	2600	6.0	350	30/64	175
73	Tex-Harvey	4,500	H-W	2300	3.3	171	24/64	125
74	Wildcat	1,500	H-W	1900	6.1	233	1/2	100

[1] Hook-Wall. [2] Straddle.

Retreatments With Stratafrac

Another Stratafrac application in the Spraberry Trend is in the stimulation of wells that already have been completed but are not making their allowable production. These wells fall into two categories: Wells that make little, if any, oil on original completion, and those that come in as good producers at first, but later undergo a rapid decline.

An example of a retreatment of this latter type was that of a well in the Benedum-Spraberry area. This well originally was rotary drilled with water-base mud. The Spraberry was perforated in the interval between 6680-6690 ft, followed by hydraulic fracturing. At this time it showed a potential of 133 bbl per day. Production from this well, however, declined rapidly, finally levelling off at around 45 bbl per day.

Assuming that the fractures in the vicinity of the well-bore had become partially blocked, the well was retreated. The formation first was flushed with 2000 gal of formation cleaner. Following this, 3000 gal of Jel-X 500 was employed. Immediately following Stratafrac treatment the well was repotentialled at 245 bbl per day, but rapidly declined to 20 bbl per day, finally dying completely. The well then was swabbed thoroughly, recovering large quantities of BS and lost circulation materials. Put back on production, it made the daily allowable for a short while, then slowly leveled off at around 75-80 bbl per day, which it has continued to produce up to the present.

It cannot be emphasized too strongly that non-producing wells in the Spraberry should not be hastily abandoned. Many a "hopeless" well has been made into a producer by employing proper stimulation techniques. At the average cost of $80,000 per drilled well, one successfully reclaimed well will more than pay for stimulation retreatments on a number of wells.

Attempts have been made to treat selectively, in stages, limited sections of open hole, isolated by a straddle packer. Because of the highly fractured nature of the Spraberry sand, this is not always successful, the fractures allowing communication through the formation and around the packer. Here again, the non-uniformity of the fracturing, from well to well, makes it difficult to predict how any given well will react to treatment.

A new development, designed to improve the efficiency of Stratafrac treatments, has been the conducting of preliminary caliper and permeability surveys, employing the electric pilot. Such surveys indicate the sub-surface conditions, enabling a better determination of the proper remedial action for the well. As a result, in many instances a selective Stratafrac job can be conducted, confirming the benefit of the treatment to specific sections of the well bore. * * *

Reservoir Performance and Oil Properties in Spraberry Fields

JOHN R. BRACK*

Performance History

STATISTICAL data are given in Table 1 concerning producing areas in the Spraberry Trend, including oil, gas, and water production, cumulative recoveries, bottom hole pressures, and gas-oil ratios.

The Seaboard Oil Company completed the S. E. Lee No. 2 January 22, 1949, in the Spraberry Deep field, Dawson County. Discovery well in the Tex-Harvey field was Tex-Harvey Oil Company, Mrs. B. W. Floyd No. 1-16. It was completed March 15, 1949, as a pumper and made 135 bbl of oil per day plus 13 per cent water. These two wells are the discovery wells for the Spraberry zone of the Leonard formation and for the big development that followed in the Midland area. Reservoir performances for 16 oil fields are listed. The latest one in this report is the Flat Rock field in Upton County, which was completed on July 21, 1951.

A recent tabulation reports 60 locations in the Tex-Harvey field with 65 rigs running.

First annual gas-oil ratio survey was turned in to the Commission on October 15, 1951. Gas-oil ratios were reported for 213 wells, the arithmetic average being 1222 cu ft per barrel. Weighted average gas-oil ratio on the basis of the volume of the fluids produced during the tests was 1237 cu ft per barrel. Only 8 gas-oil ratios of 2000 or above were reported with the highest one being 2606 cu ft per barrel. The initial gas-oil ratio for some of the older wells was approximately 554.

Arithmetic average, gas-oil ratio for 40 wells in Germania field was also reported October 15, to be 1241 cu ft per barrel, although the weighted average ratio was 1256. Two wells produced an excess of 2000, the highest ratio being 2488.

In the Midkiff field the October gas-oil ratios were submitted for 15 wells. The highest ratio in the field was reported to be 966 cu ft per barrel and the weighted average was 763. The October report for 2 of the 3 wells in the Snowden field showed an average 461 ratio.

*Ohio Oil Company, Midland, Texas.

Potential Plots

Early in the history of these fields, during which time we were trying to decide whether or not to recommend drilling, we took the initial potentials, which all the "coffee shop people" said were high in most cases, and then we had the scouts find a potential that had no definition. The second potential point is what the producers think the wells could make; it is what we gathered from some of the wells that are not making their allowable for no apparent reason; it is a conglomeration of what you might call a second potential.

That would give only two points in the history of a field—the initial potential and this "horseback" potential. The points were plotted on various types of paper. The most likely straight line for a solution drive field would be the semi-log plot of rate versus cumulative oil. As cumulative oil figures were not available, we plotted rate versus time to see what would happen and drew lines through the points. The significant thing that seemed to come up was, first of all, you shouldn't do this sort of thing, and secondly, that no matter what the original potentials were, all lines appeared to be reaching a point of equal production rate.

Using 168 wells and fully three-quarters of those appeared to be going toward the same point, which had a range of production of some 30 bbl per day, and was projected about six months into the future.

Reservoir Fluid Properties

Subsurface oil samples were obtained from the Spraberry formation and analyzed to determine reservoir fluid properties, including a determination of the saturation pressure, shut-in bottom hole

TABLE 2. Reservoir fluid properties.

Field	Pembrook	Tex-Harvey	Germania	Driver	Tex-Harvey
Well name	Ralph Pembrook B-2	Snowden No. 1[1]	Fasken 1-18	C. J. Cox No. 1	Boone No. 1
Reservoir temp., F	133	140	141	137	138
Saturation pressure, psig	2090	2320	1920	1959	1834
Formation volume factor, bbl res. oil/bbl STO	1.431	1.355	1.423	1.396	1.417
Viscosity, centipoises . . reservoir temp & press.	0.62	0.98	0.66	2.83[2]	2.34[3]
Dissolved GOR, Std cu ft per 1 bbl reservoir oil	791	677	735	714	753
API gravity of stock tank oil	36.2	37	37.7	37.1	37.0

[1] Recombined sample. [2] At 136 F and 0 psig. [3] At 139 F and 0 psig.

TABLE 1. Statistical data on some Spraberry fields.†

	Field and county	Discovery	Company	Date	Init. prod bbl	GOR	No. wells 9-1-51	August prod, bbl Total	August prod, bbl Avg/well	Cumulative prod, bbl Total	Cumulative prod, bbl Avg/well	% cumulative allowable
1	Tex-Harvey field, Midland County	Mrs. B. W. Floyd No. 1-16	Tex-Harvey	3-15-51	135	1222	250	571,805	2287	2,988,476	12,000	
2	Weddell field, Reagan County	Weddell No. 1	Blackwood & Nichols	5-23-51	209	764	4			6,186		
3	Weiner-Floyd field, Upton County	F. A. Braden No. 1-17	Ted Weiner	2-13-51	452	535	15			56,009	3,737	57%
4	Aldwell field, Reagan County	G. F. Wimberly No. 1-15	Paul F. Barnhart	6-21-51	176	880	3	2,283	761	21,220	7,073	
5	Benedum field, Upton County	Rose Halff Barnett B-2	Republic Natural Gas	4-3-50	30	593	21	34,146	1626	74,980	3,570	78%
6	Driver field, Midland & Glasscock Co.	J. W. Driver No. 1-16	Ted Weiner, et al	1-26-51	304	615	48	95,232	1984	194,867	4,060	80%
7	Flat Rock field, Upton County			7-21-51	103	1157	2			3,638		
8	Germania field, Midland County	Andrew Fasken No. 1	Cumberland & Weiner	1-3-50	100	675	40	86,960	2223	426,310	10,931	86%
9	Glass field, Martin County	G. W. Glass No. 1	Gulf Oil Company	1-13-51	100	990	1	1,252	1252	10,039	10,039	59%
10	Huddle Manning, Dawson County	D. Huddle No. 1	Fred Manning	10-10-50	186	625	1	2,303	2303	21,440	21,440	53%
11	Midkiff field, Midland County	Lilly Midkiff No. 1	Humble Oil & Refining Co.	9-20-50	80[1]	749	14	24,535	1753	66,045	4,718	90%
12	Pembrook field, Upton County	Ralph Pembrook No. 1	Humble Oil & Refining Co.	1-8-50	34[1]	517	34	67,149	1975	323,175	9,595	78%
13	North Pembrook, Upton County	V. P. Tibbett No. A-1	Paul F. Barnhart	5-14-51	343	631	17	29,298		64,870	3,228	81%
14	Smith field, Dawson County	M. V. A. Smith No. 1	Standard of Texas	11-27-50	84	423	1	2,408	2408	21,005	21,005	72%
15	Snowden field, Dawson County	Carrie S. Dean No. 1-30	James H. Snowden	5—51	160[2]	324	3			17,318		
16	Spraberry Deep, Dawson County	S. E. Lee No. 2	Seaboard Oil Co.	1-22-49	319	750	36	91,179	2533	1,252,858	34,829	99%

[1] Pumped
[2] For August only

†Taken from "Reservoir Performance" by John R. Brack.

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**In a letter to the editor of PLANT ENGINEERING, Aug. 10, 1951.*

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pressure, reservoir temperature, reservoir viscosity, original dissolved gas-oil ratio, and API gravity of the residual liquid.

Physical Properties

Oil produced from the several Spraberry fields has similar physical properties in the samples available for this report. Unfortunately, these data that have been released do not represent a complete coverage; the only ones available were from the upper Spraberry.

There is fair agreement between the reservoir temperatures at approximately 138 F, the formation volume factor at 1.4 bbl of reservoir oil per barrel of stock tank oil, the solution ratio at 725 standard cubic feet per barrel of reservoir oil, and the gravity of 36.5 API. Samples show that the oil is undersaturated, which fact is supported by the lack of any field evidence of the presence of free gas in a gas cap.

Viscosity of the oil in the reservoir at reservoir temperature and pressure varies from 0.62 centipoises to 0.98 centipoises with the several samples. On two of the samples the viscosity was reported at 2.34 centipoises and 2.83 centipoises at reservoir temperature but at atmospheric pressure.

Static pressure in the reservoir on the Snowden well in the Tex-Harvey field was 1976 psi, while the average reservoir pressure at the time the sample was taken was 2020 psi. The original reservoir pressure was estimated to be 2300 psi, and the average for June was 1958 psi with a drop of 367 psi, which indicated 8143 bbl stock tank oil per pound of reservoir drop.

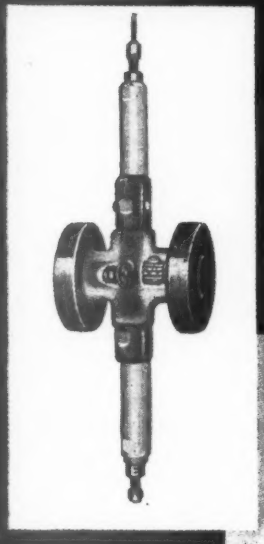
On the sample taken in the Germania field the static pressure was 1930 psi. For the Driver field shut-in pressure at 6500 ft (or –4196 datum) was 2262 psi. On the last Tex-Harvey sample, the pressure was 2240 psi at 7000 ft. * * *

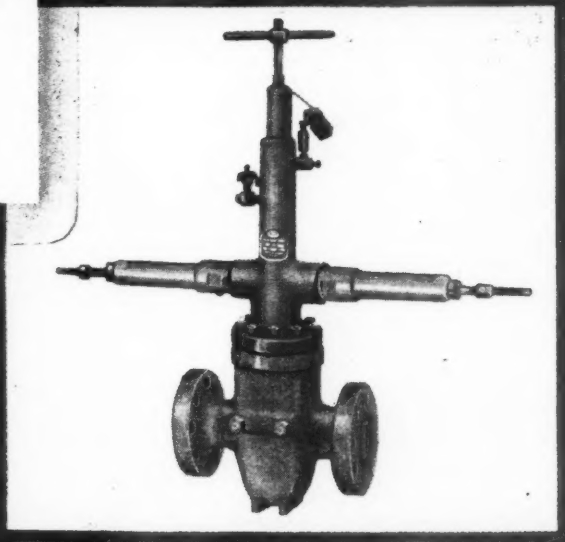
Colorado Adopts New Well Spacing Rules

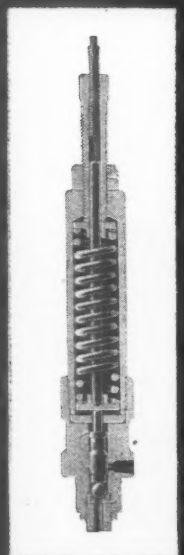
Colorado Oil and Gas Conservation Commission has adopted regulations and rules of practice governing the Commission's actions and operations of the oil industry. One of its most controversial rules is that governing spacing of wells, which was left almost unchanged from its originally proposed form. The rule as adopted requires drilling to be at least 330 ft from any property or lease line and at least 600 ft from any other producing or drilling gas or oil well. After a producing area is opened, the commission can consider spacing of each field as a separate question.

Industry men studying the spacing problem could not reach agreement, according to Commission director J. J. Zorichak. Added to this was the question of legality of statewide spacing rules under the commission's designation as a conservation agency. He added that he believed the Colorado spacing rule is similar to that in effect in Oklahoma.

Otis Surface Safety Valves







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Plans Near Completion for Annual Convention of Geologists, Geophysicists, and Paleontologists

RICHARD SNEDDON*

THE 37th annual meeting of the American Association of Petroleum Geologists will be held at the Biltmore Hotel, Los Angeles, California, on March 24-27, 1952. The 22nd annual meeting of the Society of Exploration Geophysicists will be held on the same dates, and the 26th annual meeting of the Society of Economic Paleontologists and Mineralogists will be held on March 25-27.

In general, the schedule of events will follow the custom of previous years. The nine standing committees and special committees will meet in pre-convention sessions on Sunday, March 23. Monday, March 24, is to be devoted to the business committee meeting, registration, a full-day session of the SEG and a SEPM field trip of the Los Angeles Basin scheduled for the afternoon, which includes the Palos Verdes Hills and the Los Angeles and Long Beach Harbor areas. The AAPG technical sessions will begin Monday evening. Joint session day of presidential addresses, presentation of honors, and special papers of common interest to the three societies will be Tuesday. The three societies meet in separate full-day sessions Wednesday, with an AAPG research symposium and panel discussion tentatively scheduled for Wednesday evening. Thursday the three societies will again meet in separate session, and the convention will close on Thursday evening with the annual dinner-dance and floor show. There will be post convention field trips, the details of which have already been announced through questionnaires sent to the membership.

*Pacific Coast Editor.

Technical Program

Leo R. Newfarmer, exploration manager for the Shell Oil Company, Los Angeles, California, has been appointed chairman of the technical program. The technical program will concern itself with subjects of national interest and importance as determined by committeemen from various parts of the nation, with papers grouped around three topics: (a) Topics of general or world-wide interest (joint session); (b) research subjects, and (c) geology of some newly productive and future oil provinces.

The first technical session, Monday evening, March 24, will feature a lecture on "The Great Barrier Reef of Australia and Other Reefs of the Australasian Region," by Professor Curt Teichert of the University of Melbourne, Australia. Professor Teichert will illustrate his lecture with numerous pictures of reefs and reef growth. Tuesday morning, March 25, the three societies will meet in joint session and the opening ceremonies, including addresses by national presidents of AAPG, SEG, and SEPM, will be heard. Awards and presentation of honors will also be made at this time, and Eugene Holman, president of the Standard Oil Company of New Jersey, will deliver the keynote address to the members of the three societies.

Frank A. Morgan, vice president Richfield Oil Corporation, national president of the American Association of Petroleum Geologists.

The joint sessions will be continued Tuesday afternoon beginning with a paper by Max W. Ball entitled, "The Public and the Geologist," and including foreign papers. A geophysical paper by Dr. Ben S. Weatherby entitled, "Some Uses and Abuses of the Seismic Method", and another presented under the auspices of SEPM entitled, "Shallow Water Sediments of the Northern Gulf of Mexico", by Dr. Francis P. Shepard, will complete the session.

Research will be the theme of the Wednesday session of AAPG, while SEG and SEPM will be conducting their separate sessions. Dr. Francis P. Shepard will first deliver a brief report on the progress of the API research on the origin of oil and related matters, and this will be followed by "The Sedimentology and Geochemistry of the Black Sea", by Shepard W. Lowman and Roland S. Beers. Another paper, of fundamental importance, entitled, "En-

S. Z. Natcher, assistant to vice president, Standard Oil Company of California, and chairmen of entertainment for the 22nd annual meeting.

Sam Grinsfelder, vice president, Union Oil Company of California, and hotel and housing chairman for the joint annual meeting.

Howard C. Pyle, president, Jergins Oil Company, general chairman of arrangements committee of AAPG, SEG, and SEPM meeting.

Homer J. Steiny, geologist, Tide Water Associated Oil Company, and chairman of transportation for the joint annual meeting.

trapment of Petroleum Under Hydrodynamic Conditions", will be given by Dr. M. King Hubbert. This will be followed by, "Sedimentation of Sand Under Conditions Simulating Deep Burial", by Dr. John C. Maxwell.

Wednesday afternoon will be given over to a symposium being arranged by the Research Committee, E. A. Koester, chairman. The symposium will be on the subject, "Fractured Reservoirs" and a number of very interesting papers covering a wide range of oil occurrences in fractured reservoirs has been scheduled by the research committee. Marcus A. Hanna will speak on, "Some Occurrences of Fractured Porosity in the Gulf Coast". A paper entitled "Production from Fractured Rocks in the Northern Fields of Mexico" will be presented by Henry J. Morgan, Jr. Louis J. Regan will present, "Oil Occurrences in Fractured Rocks in California", and W. M. Wilkinson will talk on "Fracturing in the Spraberry Reservoir, West Texas". Several additional papers are to be presented, including one on, "Oil Occurrences in the Fractured Shale of the Uinta Basin, Utah". Wednesday evening has also been reserved for a continuation of this symposium and the discussion it is sure to provoke.

Thursday will be the day for papers on the new or lightly explored provinces, and although exact titles are not yet available in all cases, these will include: A discussion of oil exploration in the Williston Basin, by T. R. Barnes; Dr. L. L. Sloss will discuss "Interpretive Stratigraphy of the Great Basin Region, Nevada," and a discussion of the "Tertiary Basins of Southern California and Offshore Areas", will be given by William Corey. Two or three other papers covering new or future petroleum provinces are also in prospect. The Thursday session will close with the annual business meeting.

K. C. Heald, Gulf Oil Corporation, will receive the annual AAPG Sydney Powers Memorial award. (See Page A-78.)

SEPM Technical Program

In addition to presidential addresses and joint sessions with the other two exploratory societies, the SEPM program will include separate full-day technical sessions on Wednesday and Thursday, and a field trip. The subject of the annual SEPM symposium will be, "Objectives in Modern Sedimentology and Paleontology". There will be a second symposium, "Recent Marine Sedimentation". The field trip will include visits to type localities of several well known formations that have excellent microfauna. President Thomas H. Philpott has appointed K. O. Emery, geological department, University of Southern California, Los Angeles, California, program chairman for the SEPM.

SEG Technical Program

As the AAPG and the SEPM do not schedule technical sessions on Monday, March 24, the SEG plans to present geophysical papers of general interest at its all-day Monday session. Among these will be case histories of fields and exploration techniques and results in basins of current interest. Tuesday, at the joint session with the AAPG and SEPM, Sigmund I. Hammer, president of the SEG, will give an address. In addition, Dr. Ben B. Weatherby will present a paper of general interest, "Some Uses and Abuses of the Seismic Method". The Wednesday morning session will feature papers on basic geophysical research, followed by papers

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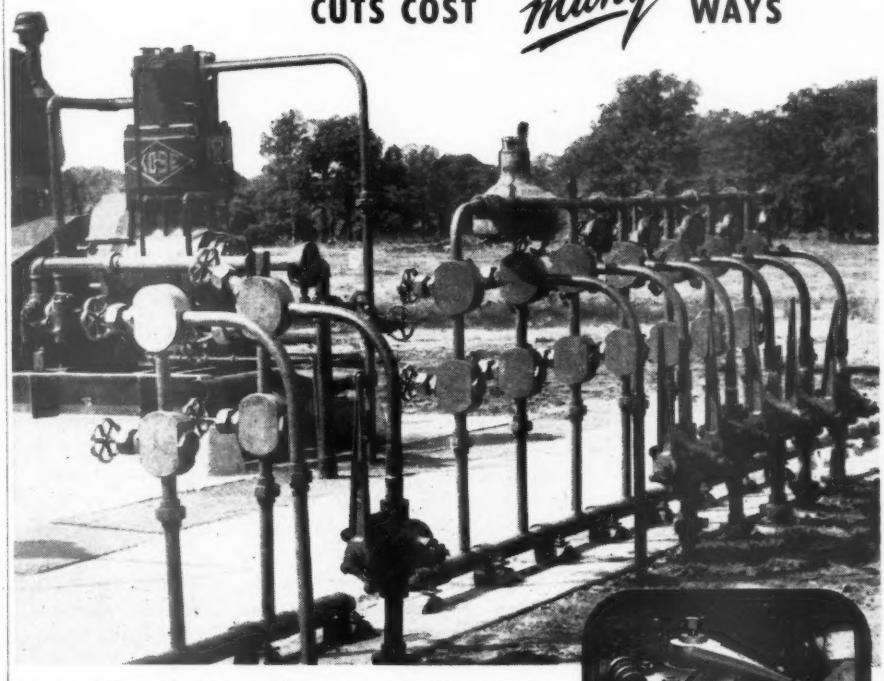

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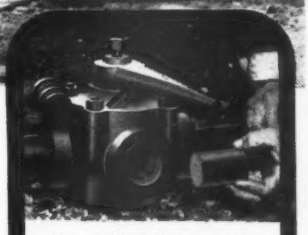

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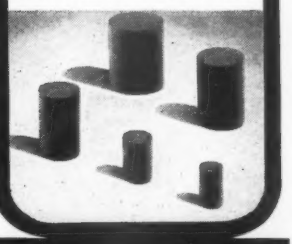

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on instrumental and interpretive techniques in the afternoon. Thursday morning, a symposium on mining geophysics will be offered for the first time since the joint annual meeting in 1947.

Program chairman for the SEG is its vice president, Curtis H. Johnson, General Petroleum Corporation, Los Angeles. The personnel of the program committee has been listed in the July and October issues of *Geophysics*.

Thursday afternoon, a field trip to the California Institute of Technology and the new laboratory of the United Geophysical Company in Pasadena has been tentatively scheduled. Theodore H. Braun, of Superior Oil Company, Los Angeles, has been appointed field trip chairman.

Entertainment

Stanlus Z. Natcher, Standard Oil Company, Los Angeles, is chairman of the committee for entertainment. In addition to the dinner-dance and floor show on Thursday night, March 27, the entertainment committee is engaged in plans for "California Style" entertainment of the visiting ladies on Tuesday afternoon and Wednesday.

Exhibits

The Biltmore Hotel will have available space for exhibits as it has in the past. Prospective exhibitors are being contacted by the exhibits chairman, Joe B. Hudson, Humble Oil and Refining Company, 612 South Flower Street, Los Angeles 17, California.

Leo R. Newfarmer, manager of exploration, Shell Oil Company, and technical program chairman for the annual meeting.

Field Trips

A second questionnaire concerning the field trips tentatively planned by the AAPG has already been mailed to the membership, and it is hoped that the field trip forms will be returned as soon as possible in order that the field trip committee may more definitely formulate plans for the trips described.

Room Reservations

The form for requesting hotel room reservations has been mailed to each member, and it is urged that there be no delay in returning the reservation form. If any member has not received the form, he may request another from Association headquarters. A copy of the form was printed in the October *Bulletin*. Because of the limited number of single rooms available, there will be a much better chance of obtaining the desired accommodations if the request calls for rooms to be occupied by two or more persons. All reservations must be cleared through the housing committee, which is headed by Sam Grinsfelder of the Union Oil Company. All requests for hotel rooms should be made by returning the form to the AAPG Housing Committee, Attention: Sam Grinsfelder, Chairman, Room 1102, 617 West Seventh Street, Los Angeles 17, California. Requests for reservations should be made as far in advance of February 20, 1952, as possible, and should contain all information requested. Receipt of requests will be acknowledged and filed in order of receipt by the housing committee. Actual assignments will be made in the various hotels, and confirmations will be mailed about 60 days prior to the convention. Members who request reservations but later find they cannot attend, should notify the housing committee without delay. Blocks of rooms will not be reserved, and all rooms must be reserved in the names of individuals.

* * *

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Wall and Bottom Hole Scrapers	Bulletin No. 58
Vertical Casing Scrapers	Bulletin No. 59

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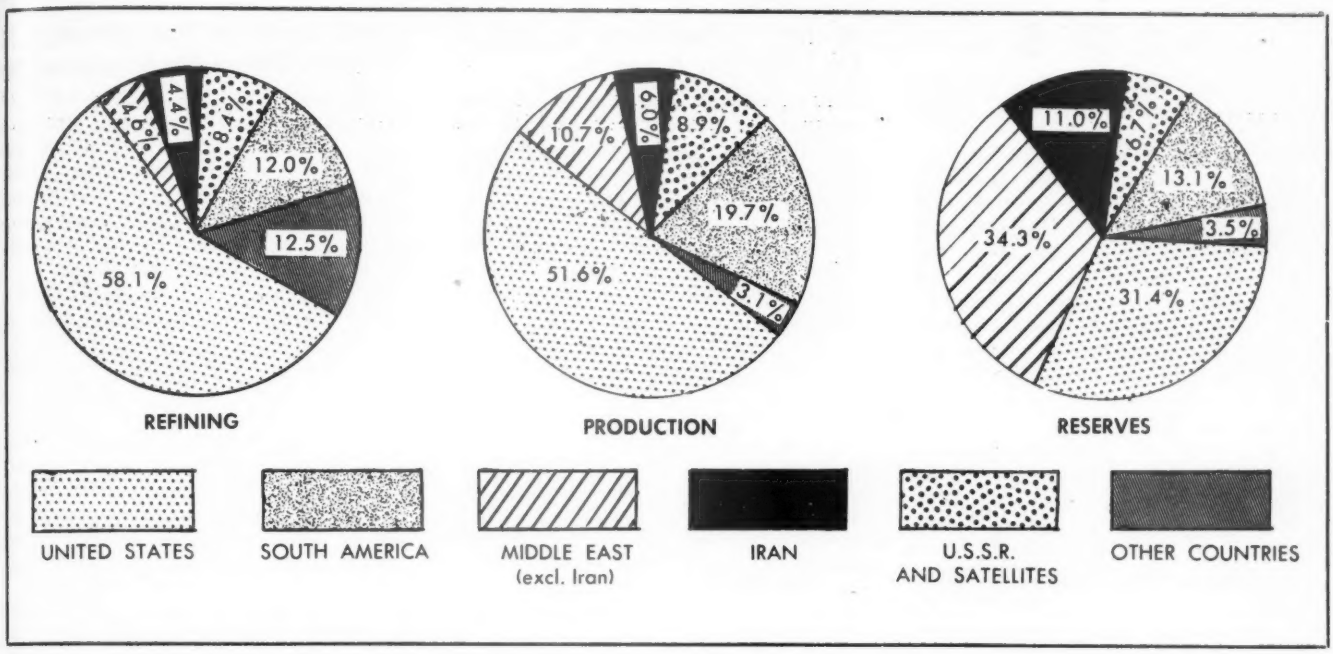

OWNERSHIP of World Oil Industry

British, American, and British-Dutch interests totaled an approximate 88 per cent of world petroleum output in 1950, London Bureau reports.

American, British, and British-Dutch interests held sway in world oil production during 1950, according to a compilation by the Petroleum Information Bureau, London, England.

United States foreign production amounted to more than 100 million metric tons, in addition to 290 million produced domestically, while British and British-Dutch interests accounted for 87 million metric tons, representing an increase of 18 per cent over the corresponding period in 1949. The combined production of British, American, and British-Dutch interests totaled approximately 480 million metric tons, or 88 per cent of the world output of 543 million metric tons.

In the Middle East, British and Dutch interests dominated the production picture, while United States companies led in Caribbean area, where Venezuela is the principal producing nation.

World oil output for the first half of 1951 is estimated to be some 300 million metric tons, which exceeds the corresponding production of any other year. The total output for the year may be 60 million metric tons above last year's record production. ★ ★ ★

1950 OWNERSHIP OF OIL PRODUCTION

In 1000 metric tons

	British and British/Dutch	U.S.	Others	Total
NORTH AMERICA—				
U.S.A.	12,240	277,950	.....	290,190
Canada*	negligible	2,330	1,550	3,880
Total	12,240	280,280	1,550	294,070
Percentage of world	*2.3*	*51.6*	*0.2*	*54.1*
LATIN AMERICA—				
Venezuela	25,100	52,390	650	78,140
Mexico	.....	.....	10,490	10,490
Colombia	1,570	3,280	.....	4,850
Argentina	490	375	2,595	3,460
Trinidad	2,910	35	35	2,980
Peru	410	1,620	20	2,050
Ecuador	370	.....	.....	370
Others	.....	.....	210	210
Total	30,850	57,700	14,000	102,550
Percentage of world	*5.6*	*10.6*	*2.6*	*18.8*
MIDDLE EAST—				
Persia	32,260	.....	.....	32,260
Saudi Arabia	.....	26,620	.....	26,620
Kuwait	8,645	8,645	.....	17,290
Iraq	3,360	1,490	1,800	6,650
Egypt	1,780	590	.....	2,370
Qatar	780	390	470	1,640
Bahrein	.....	1,510	.....	1,510
Others	.....	.....	80	80
Total	46,825	39,245	2,350	88,420
Percentage of world	*8.6*	*7.2*	*0.5*	*16.3*
FAR EAST—				
Indonesia	3,650	2,800	.....	6,450
British Borneo	4,240	.....	.....	4,240
Others	600	160	380	‡1,140
Total	8,490	2,960	380	11,830
Percentage of world	*1.6*	*0.5*	*0.1*	*2.2*
WESTERN EUROPE—				
Germany	60	180	880	1,120
Netherlands	350	350	.....	700
Others	50	4	106	160
Total	460	534	986	1,980
Percentage of world	*0.1*	*0.1*	*0.2*	*0.4*
U.S.S.R. AND EASTERN EUROPE†—				
U.S.S.R.	.....	.....	37,500	37,500
Roumania	.....	.....	4,100	4,100
Austria	.....	.....	1,600	1,600
Hungary	.....	.....	500	500
Others	.....	.....	730	730
Total	.....	.....	44,430	44,430
Percentage of world	.....	.....	*8.2*	*8.2*
World total	98,865	380,719	63,696	543,280
Per cent	*18.2*	*70.1*	*11.7*	*100.0*

* Owing to rapid development of Canadian oil resources, and very large number of companies operating, proportion of output supplied by U.S., Canadian and other interests is constantly changing.

† Best available estimates. British, British/Dutch and American interests have concessions in Eastern Europe, but at present have no real control over production.

‡ This includes Japan 280; India 260; New Guinea 260; and Pakistan 170 and it is to be regretted that the division as to ownership is not given.

NEWS

Vassen Well Shows Gas At 20,300-Ft Depth

Five-inch casing has been hauled to the world's second deepest well, George Vassen's No. 1 Tung Oil Corporation in Stone County, Mississippi. The rank wildcat had a flow of rich gas at 20,300 ft. It is bottomed at 20,450 ft, where the 5-in. casing will be run. Seven-inch casing was set at 14,038 ft. When the 5-in. string is run and cemented, Vassen plans to run the electric log and perforate and test.

The deepest hole drilled by man was the Superior Oil Corporation failure in Southwestern Wyoming to near 21,000 ft.

Bureau of Mines Reports July World Oil Output Down

In July, world crude petroleum production averaged 11,661,000 bbl daily, a decrease of 276,000 bbl from the June daily rate. Total Middle East production decreased 335,000 bbl daily due to the drop in Iranian output with the shutting in of the oil fields, excepting the Naft-i-Shah field near the Iraqi border. Kuwait, however, increased crude production 120,000 bbl daily, and Saudi Arabia's output gained 61,000 bbl daily to offset partially the loss in Iranian production. In Venezuela, production increased 18,000 bbl daily and in the United States crude output increased 11,000 bbl daily. The U. S. S. R. is estimated to have increased crude output 25,000 bbl daily. New monthly production records were established in Kuwait, Saudi Arabia, Venezuela, and in Germany in July.

Western Europe's crude petroleum imports averaged 1,071,000 bbl daily, compared with 1,105,000 in June. The major importing countries in barrels daily were: France 368,000 (June 380,000); United Kingdom, 324,000 (332,000); Italy and Trieste, 144,000 (157,000); Netherlands, 119,000 (115,000), and Western Germany 66,000 (67,000).

Figures available indicate that stocks of crude petroleum increased 77,000 bbl daily during July, with the largest increases in the United States, Canada, and Saudi Arabia. Crude oil stocks in Venezuela, United Kingdom, and Kuwait showed the largest decreases.

Wilshire Well Flows 3656 Bbl Oil Per Day

Wilshire Oil Company has completed its No. 14-118 R. S. Windham for a calculated daily flowing potential of 3656 bbl of 52.9 gravity oil, with gas-oil ratio of 674-1. This extends the Wilshire (Ellenburger) field of West Texas. Potential was based on actual flow of 1828 bbl of oil in 12 hours through a ¾-in. tubing choke from open hole between 12,250 and 12,400 ft. Open hole section was treated with 500 gal of acid.

(See Page B-7 for article on this field.)

Michigan Publishes Survey Of 1950 Oil Activities

The Michigan Department of Conservation Geological Survey Division has published a detailed booklet summarizing its 1950 operations of oil and gas fields. Oil and gas activities decreased slightly from 1949, the survey shows, with permits issued for 901 wells compared with 999 in 1949. Of the 884 wells completed, 336 produced oil, 75 produced gas, and 473 were dry holes. Footage drilled was 2,090,979, a decrease of 150,343 ft from 1949. Oil produced was 15,826,148 bbl down 377,325 bbl. Gas production declined almost 14 per cent to 12,614,024,000 cu ft.

Exploration continued at a high rate. During the year, 555 core drill permits were issued compared with 454 in 1949, the previous all time high. Northern Michigan had 297 and western Michigan 242. Of 335 wildcat wells drilled, 29 were discoveries.

Permian Basin Map Out

The Midland Map Company has announced that a second printing of its 1951 Permian Basin development map is now available. The 2-color map shows all 1951 field discoveries in red with older pools in blue, in the West Texas-Southeast New Mexico area. A quick picture of development in 1951 and earlier may be obtained from the map.

AIME Seeks to Strengthen Courses Offered in Engineering

Leading educators in the field of petroleum engineering are probing deeply into the needs of the petroleum industry this month in an attempt to determine in what way petroleum engineering courses in the nation's colleges and universities can be strengthened to meet modern requirements.

This probing is taking the form of a panel discussion at the annual meeting of the American Institute of Mining and Metallurgical Engineers being held February 18-21 in New York City's Statler Hotel.

It has long been felt in some quarters that the industry would benefit greatly by a standardization of curricula in the petroleum engineering schools of the nation. The panel discussion is bringing into the open most aspects of the problems presented by any such move.

The discussion is headed by Dr. John C. Calhoun, Jr., of Pennsylvania State College. Members of the panel are Dr. H. G. Botset of the University of Pittsburgh who will discuss "Elements of Petroleum Engineering Education," Dr. H. H. Power of the University of Texas who will speak on "Characterizing Features of the Petroleum Engineering Curriculum," and Dr. C. F. Weinaug of the University of Kansas who will discuss "Some Current Problems of Petroleum Engineering Educators."

New Oilwell store and warehouse in Odessa, Texas.

Oilwell Opens Its New Odessa Store, Warehouse

U. S. Steel's Oilwell Supply Division opened the doors of its big new Odessa, Texas, store and district warehouse recently and some 5000 leaders of the oil industry got a first-hand look at one of the Permian Basin's newest and largest supply houses.

Oilwell formally presented the store and warehouse with an open house. Hosts were all of "Oilwell's" top management officials and the division's West Texas district representatives. Fred F. Murray, "Oilwell" president, and his entire executive staff from the division's world headquarters at Dallas, Texas, were present for the event, which officially opened the new facility. The store and warehouse are situated at 1504 East Second Street. (U. S. Highway 80), approximately one mile east of Odessa.

Murray stressed the importance of the new supply and service unit, pointing out that the extensive, up-to-date facility, plus its location in the heart of the great Permian Basin operations, would provide "Oilwell" the opportunity to offer maximum and expedient service to its customers in the area. He termed the new Odessa warehouse "one of the largest branch warehouses in the Oil Well Supply Division." It will serve the entire Permian Basin area of West Texas and all of New Mexico, he said. Its stocks will back up "Oilwell's" eight branch stores in the area—at Monahans, McCamey, Denver City, Sundown, Big Spring, Snyder, Hobbs, New Mexico, and the new Odessa store.

Drilling Up 21 Per Cent In Texas Last Year

Texas oil men brought in some 10,828 producing oil wells and 923 gas wells in that state in 1951. They drilled 17,671 wells during the year, a 21 per cent increase over 1950's search, but had almost 6000 dry holes, according to a year-end roundup by the Texas Mid-Continent Oil and Gas Association. Production from these producing wells totaled approximately 978,010,000 bbl for the year. Texas Railroad Commission figures show, a 20 per cent increase from 1950.

The Commission also reported that 4041 wildcat wells were drilled in 1951, an average of almost one out of every four, with 84 per cent of them being dry. This indicated that failures hit the wildcatters about 5 per cent heavier than in 1950 when 79 per cent were dry.

Production taxes paid to the state by the oil and gas producers during fiscal 1951, which ended August 31, were 36 per cent heavier than the year before. The Comptroller accounted for some $126,000,000, the state's largest single revenue source. During 1951, the oil and gas producers were taxed for 31 per cent of the total tax revenues of the state government. More than a third of the funds for schools came from oil and gas revenues.

Exploration Consultants Enlarge Organization

William Ross Cabeen and Associates, exploration consultants, are expanding their organization. Executive offices, headed by William Ross Cabeen, are in North Hollywood, California. The Mid-Continent office has moved to the Ledbetter Building at 320 North Broadway, Oklahoma City, Oklahoma. A West Texas-New Mexico office has been established recently in the Pelletier Building, at 404 West Illinois, Midland, Texas. Cabeen's staff first opened offices in Oklahoma City during October, 1950.

S. T. Fee, formerly associated with Shell Oil Company as geologist, has joined the organization and will be in the Mid-Continent office. Owen W. "Buzz" Fauntleroy, formerly with J. M. Huber Corporation in Wichita, Kansas, has been transferred from Oklahoma City to the Midland office. C. W. "Chuck" Allen will divide his time between the two branch offices.

Stanolind Opens New North Dakota Office

Stanolind Oil and Gas has opened a new exploration district office at Bismarck, North Dakota. T. S. Yancey, district landman, formerly of Abilene, Texas, will be in charge of the office.

Increased activity in North Dakota made it necessary to divide that district and the Montana one. Operations for the Dakota area had formerly been handled out of the Billings, Montana, office. The new office will take care of business for both the Dakotas.

Potential Oil Areas Shown in Two Charts and Map

Two new charts and a map to serve in indicating potential development of oil and gas fields in the United States have been published by the Geological Survey of the Department of the Interior.

One chart shows the complex interfingering of black shales and other rocks in west-central New York and northwestern Pennsylvania and the other chart the northwestern part of Wyoming.

The 2-page map indicates the developed oil and gas fields of the U. S. as of March, 1951, and also shows the areas of outcrop of important oil-shale beds and igneous and metamorphic basement rocks.

Copies of the charts and map may be obtained from the Chief of Distribution, Geological Survey, Washington 25, D. C. The charts are titled, "Stratigraphy of the Late Devonian Perrysburg Formation in Western and West-Central New York," and its cost is 40 cents. The other is called, "Stratigraphic sections of Cretaceous Rocks in Northeastern Teton County, Wyoming," 75 cents. The map may be had for $1.50, and is titled "Oil and Gas Fields of the United States."

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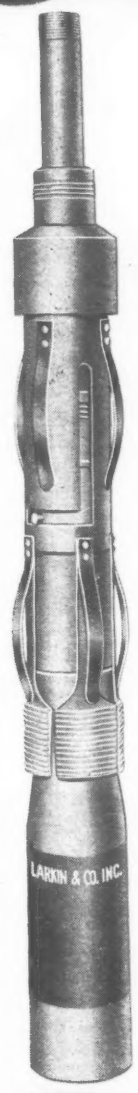

LARKIN of Butler

Modified

Upside-Down Packer

The Modified Upside Down Packer, C-104, has been tested and approved for use in confining high pressures in your wells. It is used by operators to increase oil and gas production by fracturing the formation and lifting the over-burden.

Once the Packer is set further pressure through the tubing serves only to tighten the Packer more. Because of this feature it is ideal for use when applying pressures INTO the Well for fracturing — for acidizing — for gell or plastic shut-off or for confining water pressures in Secondary Recovery operations.

An added feature of this Packer is that it removes easily two ways. Write for further information.

"SERVING the INDUSTRY since 1878"

C-104

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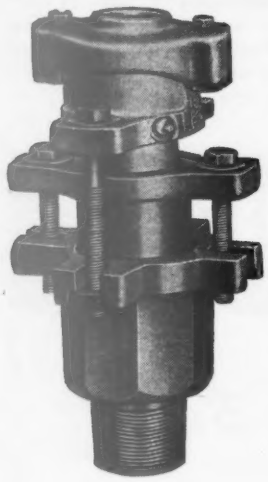
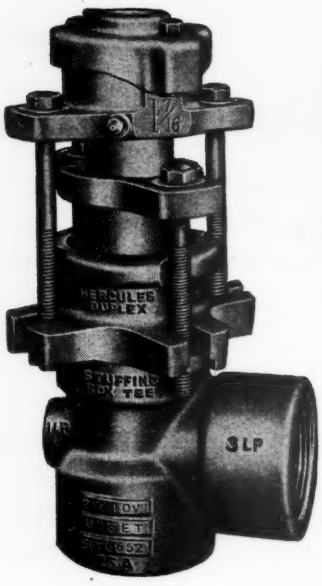
LARKIN & COMPANY, INC. · BUTLER, PENNSYLVANIA

Hercules Rod Tools
"Designed to Stand Out Built to Stand Up"

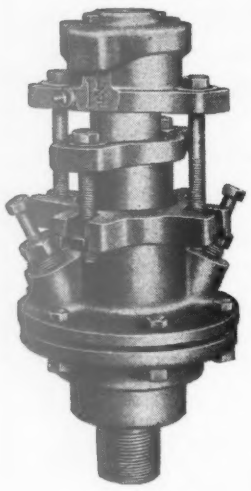


All Hercules Duplex Polished Rod Stuffing Boxes are Cone Packed for longest possible life and greatest economy. Illustrated (left) is Regular Type. Write for Bulletin 120-SB.

The Tee-Base Type Combination Stuffing Box and Tee (directly below) have been proven by years of service and savings to producers. Write for Bulletin 121-SBT.



A double packed Stuffing Box for use under most adverse pumping and flowing conditions (below). Be sure to order Type A-123-SBDP.



For greater savings, replace old style Upper Glands with the New Hercules Lubricating Upper Gland, as shown on Stuffing Boxes illustrated.

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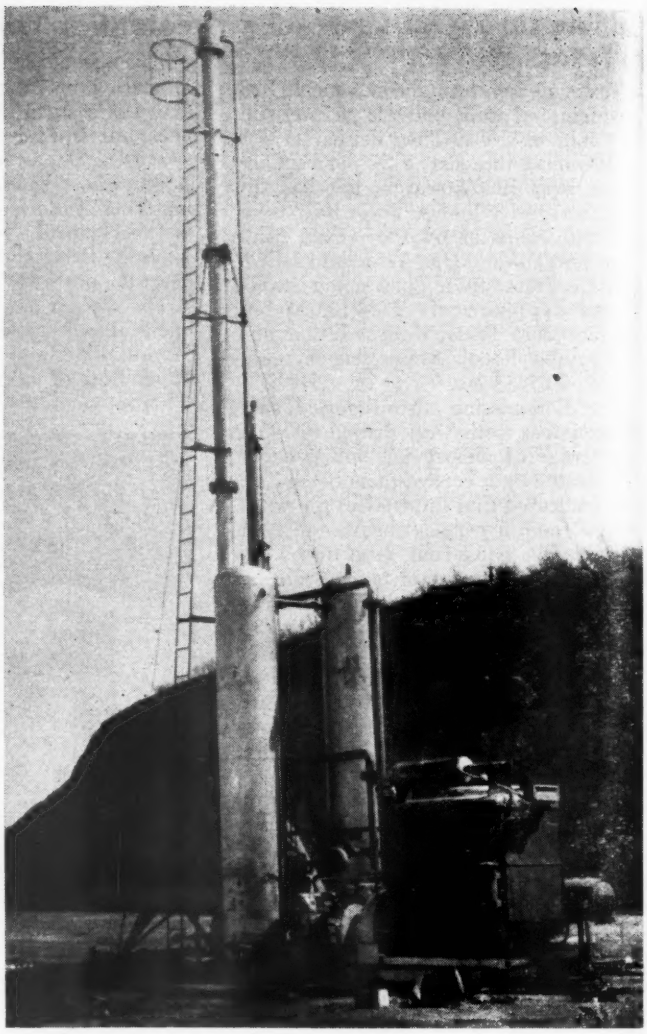
General Office and Plant: 17th and Phoenix P. O. Box 286 — TULSA, OKLAHOMA — Telephone 3-1186 Cable Address "HERTOCO"



Hydraulic pumping unit in Ventura well.

Ventura Well Uses 30-ft Stroke Pumping Unit

Shell-General Petroleum, Hartman Ranch Well No. 14 at Ventura, is location of the first Vickers hydraulic pumping unit in service for more than six months. This unit has a 30 ft stroke. Polished rod load capacity is 35,000 lb and maximum recommended speed is six strokes per minute.

Pump depth on this well is 10,509 ft, and the plunger size is 1½-in. Tubing size is 2½-in. upset and the tubing is anchored at 9500 ft. A tapered rod string is used and the present speed is 5 strokes per minute.

Navy Recovers Oil in Teapot Dome Well

Navy petroleum reserve officials have reported recovery of oil in a well in the Teapot field of Wyoming. This is the first well drilled in the field since it was shut in 25 years ago, and the first ever drilled below the Frontier sand in the 15-square mile naval field in Wyoming's Natrona County near Casper.

A drillstem test at 3570-600 ft recovered 540 ft of clean oil and 255 ft of oily mud. Drilling is going ahead. Officials reported this is one of 2 to 4 exploratory wells the Navy is planning in the Teapot area. Congress appropriated $300,000 for work this year.

McConnell Drilling Moves to North Dakota

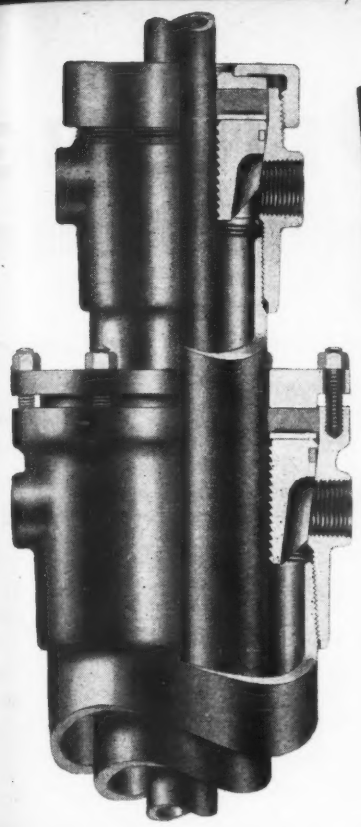
The McConnell Drilling Company recently moved its offices to Bismarck, North Dakota, from Dallas, Texas, to be near the scene of future development in the Williston Basin.

W. O. McConnell, of Farmington, New Mexico, founder, was in charge of the drilling of the Shell Oil Company's No. 1 Northern Pacific, wildcat discovery in Richey, eastern Montana.

The firm has 7 rotary rigs that will operate out of Bismarck in the Williston Basin.

RECTOR REDHEAD

gives you widest variety of low-pressure casing and tubing head arrangements.



Type R Forged Steel Casing and Tubing Heads

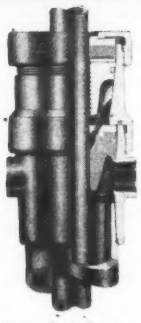
Designed and manufactured by the industry's leading producer of high pressure heads, the RECTOR REDHEAD has innumerable features that put it far ahead of the field of low cost, low pressure, forged steel casing and tubing heads.

Ruggedly constructed, the bodies have greater thickness and strength than any casing or tubing to which they will be attached. Case hardened slips are three-segment type with ribbed construction to permit full flow to the outlets. An oil resistant pack-off rests on a split junk ring directly on the slips. On the casing heads this packing is secured by a split gland bolted to the head body. On the tubing head it is secured by a gland tightened down by a screw cap on top of the head.

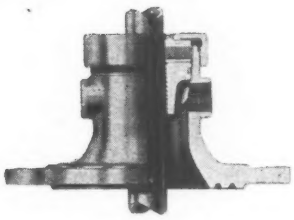
A slip bowl adapter is available to carry slips, packing and gland so that a stripper can be carried in the tubing head body. Stripper and slips are interchangeable in bowl and head body so that two strippers can be used.

Type R Casing and Tubing Heads are available with flanged or threaded bottom connection. Male threaded and flanged drilling adapters are available for screwing on top of the Tubing Head. A special threaded mandrel is available when head is used with Kobe Pump.

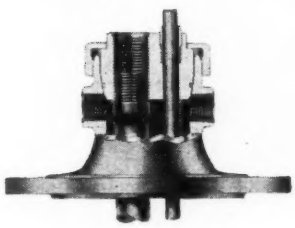
Ask your nearest Rector Representative, authorized Supply Store, or write for complete details about the Rector Redhead.



● Threaded bottom Type R Tubing Head with slips and stripper. For work-over jobs a second stripper can be used in place of the slips in the adapter bowl. Slips and stripper are interchangeable in head and bowl.



● The Type R Tubing Head with light flange for use on low pressure well having a flanged casing head . . . or to replace high pressure tubing head and tree when changing from flowing to pumping conditions.



● The original tubing head installation can be adapted to the Kobe Pump simply by using the special threaded mandrel with stuffing box for the power lines. The mandrel, resting on a ground joint seat, has an "O" ring seal.

● Type "R" Casing Head with threaded bottom. Notice how ribbed construction of slips permits full flow to side outlets, also simplicity and effectiveness of sealing arrangement.

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RECTORHEAD RECTOR FULBORE CEMENTING METHOD RECTORSEAL

WHAT'S DOING IN DRILLING

Operators Test Third Zone In North Dakota Oil Well

A third oil zone has been cored and tested at the M. B. Rudman-American Viking-Tioga Petroleum Corporation Math Iverson No. 1, Williams County, North Dakota, according to the information just released by the operators. Drillstem tests and cores of the Devonian section from 9873 to 10,489 ft show approximately 90 ft of sand that will produce commercially after acidization. Production is expected from the fractured zones in the Devonian with the best indication in the dolomitic section, which has a vugular zone about 25 ft thick.

First zone encountered was at 8267 to 8500 ft in Madison lime, 130 effective pay flowing 40 bbl an hour of 45 gravity paraffin base oil on a three hour test. On second zone, the well was cored from 9873 to 9922 ft with the testing tool set 9873, open one hour and 45 minutes. This test resulted in 850 ft of oil and gas cut mud and some free oil.

Test was run 500 ft above the Devonian area of the Clarence Iverson No. 1 discovery well, which is one and a half miles north of the Math Iverson. The discovery well, in addition to an upper Devonian, has a lower Devonian that flowed 55 gravity oil at 11,630-11,660 ft. It is expected that the Math Iverson will produce as much from the Devonian zone as the Clarence Iverson from a comparable Devonian.

Rudman, Texas independent oil producer, and Critchell Parsons of Dallas, president of Tioga Petroleum, are the first independent producers to bring in a producing well in North Dakota.

Wilshire Field Gets Large Oil Well

Standard Oil Company of Texas has reported a prolific oil well in the Wilshire field, Upton County, Texas. The well was completed flowing 1831 bbl of 53.2 gravity oil in 12 hours through ¾-in. choke. It was bottomed at 12,380 ft, and had a gas-oil ratio of 582 to 1. Tubing pressure was 825 lb, and casing pressure 1300 lb.

Shell Drills New Well In Oklahoma Pool

A new producer, flowing 567 bbl of oil per day has been completed in the Beckham County, Oklahoma, sector of the Elk City field. The new well is Shell Oil Company's No. 3 Fender "B", which was plugged back to 10,284 ft. It flowed 567 bbl of 50.9 gravity oil in 24 hours through a 22/64-in. choke for perforations between 9810-30 ft and between 9850-9910 ft. Gas-oil ratio was 2256 to 1.

Rotary Rigs Operating in Oil Fields of United States and Canada*

Weeks	Total	Gulf Coast	Pacific Coast	Illinois Oklahoma Kansas	Arkansas Louisiana Texas	Rocky Mountain Canada	New Mexico West Texas	North† Texas
(December)								
Third	3165	641	185	724	197	365	1053	
Fourth	3116	663	180	679	206	351	1037	
Fifth	3060	643	179	654	191	333	729	327
(January)								
First	2973	638	179	825	192	325	732	313
Second	2967	651	175	585	186	325	732	313
Third	2961	628	169	590	183	348	735	308

†The former West Texas and New Mexico area will henceforth be divided into two areas: West Texas and New Mexico area and North Texas area.
*As reported to the American Association of Oilwell Drilling Contractors by Hughes Tool Company.

New Spraberry Discovery Made in Reagan County

The Devonian Company has completed its No. 1 Sugg in Reagan County, West Texas as an extension to the Seven D field. The exploration is 2½ miles northeast of the discovery for Spraberry production in the Seven D field and 12 miles northeast of Stiles. That area also has production from the Wolfcamp formation.

The new well swabbed and flowed 145 bbl of fluid in 24 hours. Oil is coming from a perforated section at 5632-40 ft and from open hole between the bottom of the casing, which is cemented at 5641 ft.

Mississippi Gets New Field Well

Hassie Hunt Trust has added a new well to the Tinsley field of Yazoo County, Mississippi, with completion of its No. 9 Johnson. The well pumped at the rate of 81 bbl per day plus 6 per cent basic sediment and water from the perforated interval at 5283-89 ft. Hole was bottomed at 5315 ft.

Fourth Zone Opened In California Field

Humble Oil and Refining Company has opened the fourth producing zone in the Castiac Junction field, Los Angeles County, California. Zone opener is the company's No. 8 Newhall Land and Farming, about midway along the 2-mile trend of production that has been established on the southeast dipping anticline. It topped the new zone at 10,795 ft and cored about 150 ft net oil sand above 11,000 ft. Tests were made at 10,862-84 ft.

Seaboard Oil Completes Oklahoma Field Well

A new well has been successfully completed in the Fox Graham pool, Carter County, Oklahoma. It is Seaboard Oil of Delaware and others! No. 1-A Carpenter, which was drilled to 5455 ft. Seven-inch casing was set at 5135 ft, and the well was plugged back to 5100 ft. perforated the second Carpenter sand at 5032-42 ft to flow 300 bbl of 37 gravity oil in 24 hours through a ⅜-in. tubing choke. Gas-oil ratio was 415-to-1.

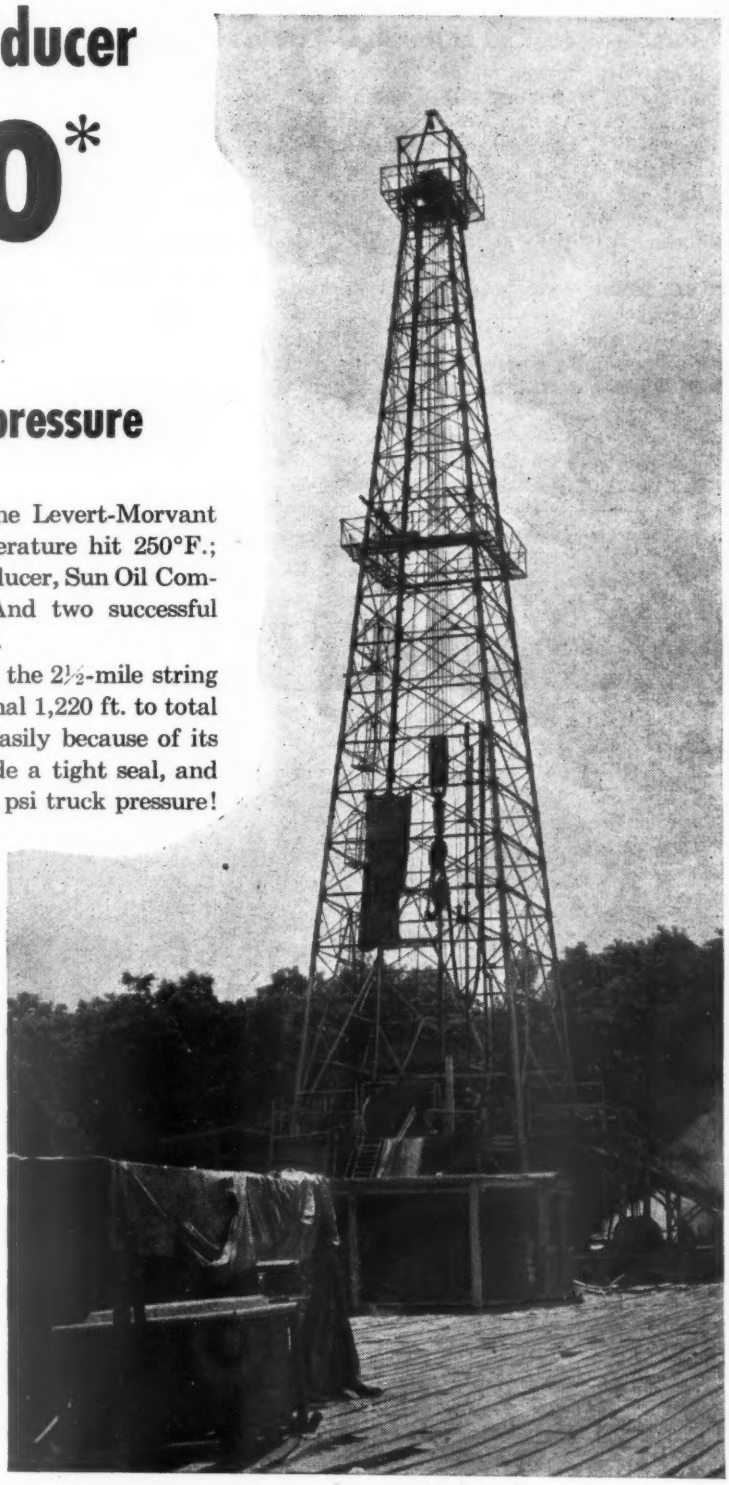
Scene from Wilshire-Ellenburger field, Upton County, Texas. Foreground is wellhead of McElroy No. 24-19. Drilling activity in background. See page B-7 for full story.

In their deepest producer

UNAFLO*

pumped easily

despite extreme heat and pressure



Down 14,506 ft. in Louisiana's Chacahoula field, the Levert-Morvant No. 2 ran into severe cementing conditions. Temperature hit 250°F.; bottom hole pressure, 9500 psi! For their deepest producer, Sun Oil Company chose dependable Unaflo Oil-Well Cement. And two successful cementing jobs—casing and liner—proved them right.

In just 90 minutes, Unaflo went in place around the 2½-mile string of 7″ casing. Then a 5″ liner was cemented an additional 1,220 ft. to total depth. Despite heat and pressure, Unaflo pumped easily because of its retarded set. A squeeze was not needed. Unaflo made a tight seal, and the formation did not break down, even under 4,800 psi truck pressure!

Whether your next job is hot and deep, or a routine cementing operation where delays *could* crop up, you can rely on Unaflo 3-way protection!

EASY FLOWING—Unaflo's high *initial* fluidity makes pumping easier right from the start.

SUSTAINED FLUIDITY—Unaflo isn't just "slow-setting." It's a retarded cement and *stays* fluid and pumpable throughout the retardation period. There's ample time, even in emergencies, to get the cement in place.

HARDENS NORMALLY—Unaflo, after its retarded period, makes a strong, tight seal—resistant to sulfate waters.

Helpful free bulletin gives facts-and-figures comparison of Unaflo's well-bottom performance with that of other cements. For your copy write: Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

"UNAFLO" is the registered trade mark of the retarded oil-well cement manufactured by Universal Atlas Cement Company

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Universal Atlas Cement Company

OIL-FIELD CEMENTS

Unaflo *Retarded* Oil-Well Cement
Resistant to Sulfate Waters
Atlas Portland Cement—Type I

Atlas Portland Cement—Type II
Resistant to Sulfate Waters
Atlas High-Early Cement—Type III

PE-U-124

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

Murchison to Test El Roble Oil Field

Clint Murchison, Dallas, Texas, oil man, and associates will develop the deep sand of the El Roble oil field of Pantepec Oil Company, C. A., in eastern Venezuela, it has been announced by Pantepec president, Louis W. Storms, Jr. The Murchison group, under the contract, will drill at its own risk and expense 8 test wells to seek production from the Mercure sand formations which occur at 10,500 to 12,000 ft in the area.

According to the contract Pentepec and Murchison will further develop and operate the field on a 50-50 basis after the Murchison investment in the test wells has been reimbursed from 75 per cent of the production on a sliding scale basis. The contract further stipulates that Pantepec will act as operator of the field. Production has been maintained at an all time high in Venezuela, the number of rigs slowly increasing.

Kentucky Pool Extended In Henderson County

Felmont Oil Corporation is extending production in the Spottsville pool, Henderson County, Kentucky. Extension well swabbed 296 bbl of oil in the first 24 hours while testing its Aux Vases pay zone at 2172-80 ft. Producing zone was treated with 2700 gal of acid.

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ROCKFORD CLUTCH DIVISION
BORG-WARNER
1303 Eighteenth Street, Rockford, Illinois

ROCKFORD CLUTCHES

Amerada Extends Well In Lea County, New Mexico

Production has been extended in the East Caprock (Devonian) field in Lea County, New Mexico, with successful completion of Amerada Petroleum Corporation's No. 1-ECC States.

It was given 24-hour potential of 520.8 bbl of 42.8 gravity oil, no water, with gas-oil ratio of 20 to 1. Potential was based on a natural flow of 379.77 bbl of oil in 17½ hours through a 12/64-in. choke from open hole between 11,170 ft, where 5½-in. casing was cemented, and 11,240 ft, the total depth.

Continental Finds Oil in Tensleep Area of Wyoming

Continental Oil Company's No. 98 Unit added considerable reserve for the Meadow Creek field, Johnson County, Wyoming. Oil was recovered on one-hour drill stem test at 8989-9056 ft in the top of the Tensleep. The well made 5500 ft of 30 gravity oil. Other oil at that approximate gravity has been found in other Tensleep producing fields of the region. Discovery of oil in the Tensleep will call for considerable additional drilling to that formation.

Tide Water Completes Two California Wells

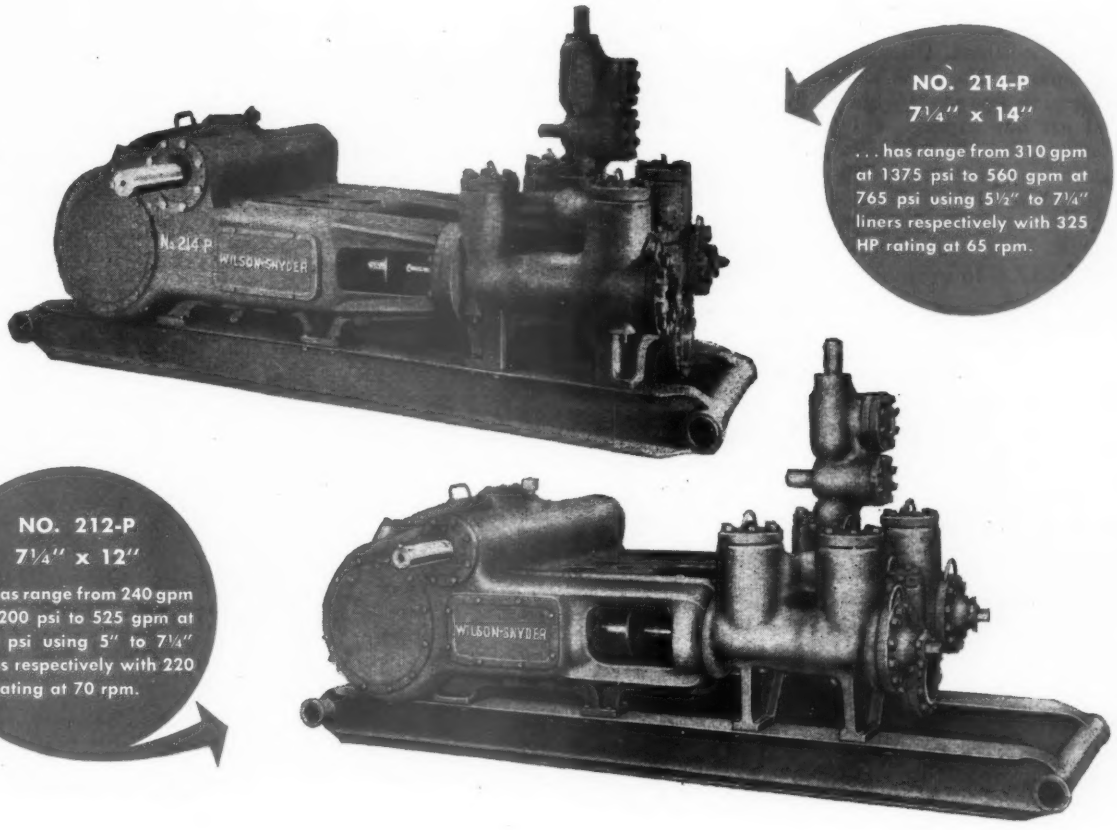
Tide Water Associated Oil Company has announced successful completion of two wells, Ventura Avenue Field, California; V. L. & W. NBR 79 and McGonigle NBR 32. The well NBR 79 flowed at the rate of 645 bbl per day, gravity 33.8, from a total depth of 10,850 ft. The McGonigle well NBR 32 flowed at the rate of 567 bbl net oil per day, gravity 31.5, from a total depth of 13,175 ft.

Indiana Pool Deepened

A new and deeper producing zone is being opened in the Belknap East pool, Vanderburgh County, Indiana, by the Indiana Farm Bureau. The new zone is the Aux Vases, which has been discovered at the company's No. 1 Schwitz. A 60-minute drill stem test of that interval recovered 1770 ft of clean oil with bottom hole pressure of 850 psi. The three wells already completed in the pool are producing from the Biehl sand.

FLOOD "DRILLS" OIL WELL IN CELLAR

Scientists generally need complicated instruments to find petroleum deposits, but in Indiana recently a Wabash River flood pushed crude oil up through the basement of a home. Experts theorize that the house stands on an oil reef, a porous rock formation which holds petroleum, and that pressure of the flood waters forced the oil out of the ground.



NO. 214-P
7¼" x 14"
. . . has range from 310 gpm at 1375 psi to 560 gpm at 765 psi using 5½" to 7¼" liners respectively with 325 HP rating at 65 rpm.

NO. 212-P
7¼" x 12"
. . . has range from 240 gpm at 1200 psi to 525 gpm at 550 psi using 5" to 7¼" liners respectively with 220 HP rating at 70 rpm.

For Medium-Depth Drilling You Can't Beat These Two

WILSON-SNYDER DUPLEX POWER PUMPS

Two important sizes in the Wilson-Snyder line of Power Pumps are the 214-P and the 212-P, built especially for medium depth drilling.
Here are a few of their many features:
One-piece, high-strength power frame.
One-piece, direct-flow type, cast steel fluid end with large passages for easy flow.
Heavy-duty, field-adjustable roller bearings throughout.
DI-HARD, long-life, fluid-cylinder liners and HI-HARD piston rods.
Forged alloy-steel, heat-treated, fluid valves and seats.
Power end lubricated with combination oilbath and positive-flow lubrication.
Cross-head pin roller bearings, diaphragm stuffing boxes, and fluid-end stuffing boxes are pressure grease-lubricated.

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New Zone Discovery Is Made in Louisiana Field

Justiss Mears Oil Company has two new wells in the new Belah field, La-Salle Parish, Louisiana. Discovery well was the company's No. 1 W. L. Valentine et al, which flowed 216 bbl of 39 gravity oil per day through a 1/64-in. choke. Casing pressure was 1395 psig, with initial tubing pressure at 760 psig. Gas oil ratio was 44 to 1. Total depth is 4140 ft. The company later set pipe at its 1 T. E. Windham, after logging Wilson sand.

Heads Tulsa AAODC

Frank Frawley, Frawley Drilling Company, was elected chairman of the Tulsa, Oklahoma, chapter of the American Association of Oil Well Drilling Contractors, at the chapter's annual meeting recently. He succeeds W. S. Frisbie, Frisbie and Yancey Drilling Company. New vice chairman is S. M. Blevens, Arrow Drilling Company, with William (Bill) Weaver, Loffland Brothers Drilling Company, as secretary. A. R. Olson, son of drilling contractor, A. O. Olson, is the retiring vice chairman. Directors include George H. Lang, Beacon Drilling; R. W. Wire, Loffland Brothers; Glenn Campbell, Campbell Drilling; I. H. Patton, Arrow Drilling; Gregg E. Sawyer, Sawyer Drilling Company, and J. L. Stauss, Falcon-Seaboard Drilling, Frisbie, and Olson.

Phillips Hits Large Canadian Gas Well

Phillips Petroleum Company and associates are completing a 46,000,000 cu ft gas well in the Kindersley area of West Central Saskatchewan Province, Canada, approximately 100 miles southwest of Saskatoon. The new gas strike No. 2 Brock was made through perforations in the Viking sand near the base of the Upper Cretaceous at a depth of 2347-58 ft. This well previously flowed at a rate of 8,000,000 cu ft of gas per day on a drill stem test 2314-46 ft, which is above the perforated interval.

The first gas well in the area, No. 1 Brock, one and one-half miles northwest of the No. 2 Brock, was recently completed for 18,000,000 ft from Viking sand perforations 2364-77 ft. The third well in this area, No. 3 Brock, one mile northeast of the first well, is now drilling.

Deep Brazil Well

The deepest well in Brazil has been drilled for the Conselho Nacional do Petroleo of Brazil by Drilling and Producing Company, Inc. of United States. Completed this spring, the well went to 13,213 ft and was abandoned as a dry well. Site of the deep well is the Tocantins River near its junction with the Para River, about 150 kilometers from the city of Belem.

Stanolind Opens Deep Zone In Oklahoma Oil Field

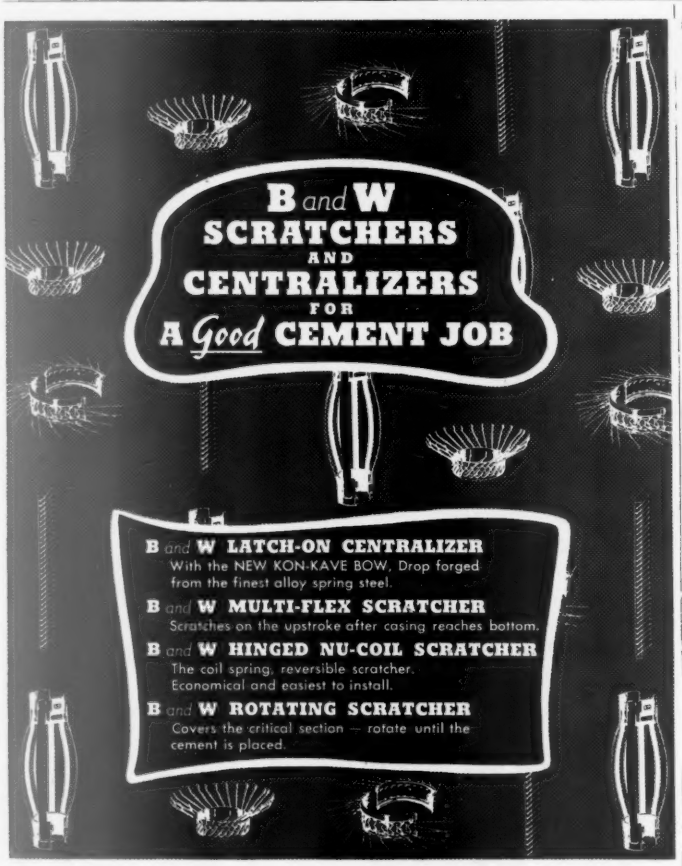
A new and deeper oil zone has been opened by Stanolind Oil and Gas Company in the Sholem Alechem field of Carter County, Oklahoma, at the company's No. 1 Brady. The well flowed 41 bbl of oil in 8 hours through chokes from sand tentatively identified as the Springer at 7440-46 ft. Gas oil ratio was 25,201-1. Original production was from the Humphreys sand some 1000 ft higher up in the hole.

Kentucky Gets New Well In Big Sandy Field

In the Big Sandy gas field, Pike County, Kentucky, a new gas well has been completed by West Virginia Gas Company. It is the No. 6023 J. Lee Ferguson, which made a small well producing 94,000 cu ft of gas daily from Devonian black shale at a total depth of 3946 ft.

Magnolia Opens New Oklahoma Oil Well

A new Hart sand oil field has been opened in southeast Grady County, Oklahoma, at Magnolia Petroleum Company's No. 1 Woodruff. The new well has been drilled to 10,019 ft, and perforated at 8960-92 ft. It flowed 136 bbl of 41.8 gravity oil in 24 hours through a ½-in. choke. Gas-oil ratio was 580 to 1.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With the NEW KON-KAVE BOW. Drop forged from the finest alloy spring steel.
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Scratches on the upstroke after casing reaches bottom.
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The coil spring, reversible scratcher. Economical and easiest to install.
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Covers the critical section — rotate until the cement is placed.

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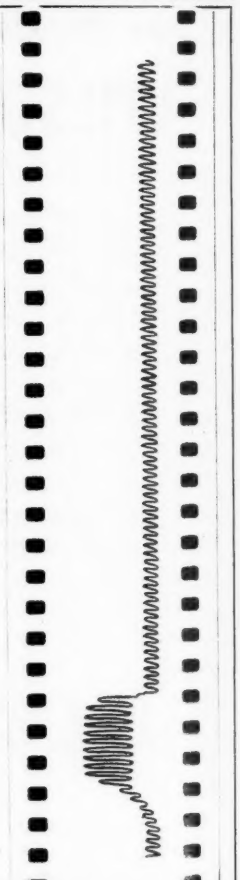

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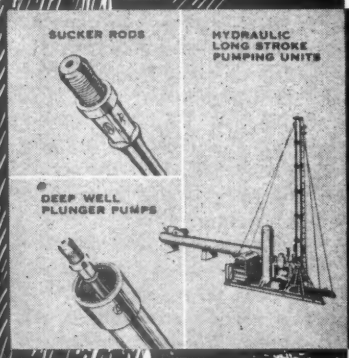

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EXPLORATION ACTIVITIES

Wildcat Successful In Escambia, Alabama

Humble Oil and Refining has reported a rank wildcat in Escambia County, Alabama, which opens a lower Tuscaloosa sand field in the southern part of the state. The well is credited with logging some 25 ft of pay sand. Production was indicated in the top 5 ft of the sand at 5945-50 ft on a drillstem test. Recovery in 26 minutes was 4650 ft of oil with no water.

In coring ahead, 20 more ft of oil sand was found. The well is significant in that it is 12 miles south and 38 miles east of nearest production.

Kentucky Gets New Field

An exceptionally large well for the western part of Kentucky has been reported in Webster County. It is the George N. Wrather and associates' No. 1 Mahourin-Luck Community, a wildcat near the McLean County line. Two zones were found in the McCloskey lime to flow 1000 bbl in the first 21 hours and 512 bbl the first full 24 hours. The well opens Kentucky's first new oil field for the year. Nearest production is the Onton pool 1⅛ miles away.

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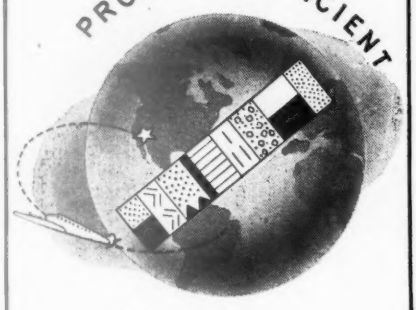

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Shallow Well Drilled By Carter in Illinois

Carter Oil Company has a new discovery oil well on the east side on Bull Island, White County, Illinois, at its No. 2 Carroll. Pipe has been set on the well after a 2-hour drillstem test of the Clore sand recovered 120 ft of gas, 570 ft of clean oil, and 50 ft of oil-cut mud; with bottom hole pressure at 661 lb. Producing zone is from 1866 to 1881 ft, though the well was drilled to 3071 ft.

West Virginia Well

F. S. Deem has completed a new well in the Ravenswood district, Jackson County, West Virginia. The new well was completed at 40 bbl daily in the Berea sand at 2150 ft.

Assam Oil To Drill Test in Brahmaputra Valley, India

A deep test of oil possibilities in the Brahmaputra Valley, Assam, India, is to begin drilling early this year, the Assam Oil Company, Ltd., (an affiliate of Anglo-Iranian) has announced in Digboi.

Location for the well has been fixed, the site being close to the Assam railway about one and three quarter miles north of Nahorkatiya station, 13 miles south of Tinsukia, in the northeast corner of the state.

The latest type of deep drilling equipment will be used to drill the well, and it is planned to go as deep as 15,000 ft if necessary. Preparations are now in hand to assemble plant and materials at the site and to erect the 136 ft high drilling derrick. Drilling operations will start early in 1952.

The drilling of this test is the outcome of intensive exploration throughout 8000 sq miles of the Brahmaputra Valley and the adjoining hills.

In the valley itself the possible oil-bearing rocks are concealed by alluvial deposits. It has been necessary to try to see beneath this alluvium by means of geophysical surveys. For this purpose, British and American experts, equipped with the most up-to-date instruments, were specially engaged to make gravimeter and seismic surveys over the area.

These surveys have suggested that the site chosen near Nahorkatiya would be a good place for a test well, and as the well progresses it will be learned whether there is any chance of oil being found in this area.

The Assam Oil Company has another test well drilling at Nichuguard, about 10 miles from Dimapur, in the Naga Hills of Assam. This well in December, 1951, was 3697 ft deep, but has not yet given any sign of oil production.

Test wells recently drilled by the company at Tiru Hills and Barsilla, also in Assam, failed to find oil.

West Texas Discovery Drilled by Humble

A new Mississippian discovery is indicated in the Humble Oil and Refining Company well, No. 2-C R. M. Evans, in northeast Winkler County, West Texas. The test was drilled to 8923 ft, with 27.7 bbl of oil swabbed on the section from 8872 to 8923 ft after a 1000-gal acid treatment. Gravity of the oil was 35.8. The well flowed one hour on 10/64-in. choke and made 7.2 bbl of oil. Gas oil ratio was 250-1, with the well still flowing to test. The Mississippian was topped at 8530 ft.

New Oil Find in Louisiana

In South Louisiana, west of the Chalkey area of Cameron Parish, a new oil discovery has been made. It is the Caroline Hunt Sands, Dallas, 1 Sweetlake Land and Oil Company. On initial test the well flowed 150 bbl of 44.4 gravity oil daily through a 1/64-in. choke from 9384 to 9389 ft. Tubing pressure was 1050 lb and gas oil ratio was 400-1. The well was drilled to a total depth of 11,932 ft.

New Mexico Test Reveals Gas and Condensate Shows

Good shows of gas and distillate have been found at Humble Oil and Refining Company's No. 1 Feder-Elliott wildcat well in Lea, New Mexico. Shows were found on a drillstem test at 12,960-895 ft in an unidentified lime and sand. Testing tool was open two hours, and gas came to the surface in 40 minutes. Gas was at the rate of 1,480,000 cu ft per day, and recovery was 981 ft of distillate and distillate cut mud.

Cities Service Finds Texas Gas Well

Cities Service Oil Company has discovered new gas and condensate production in Lavaca County, Texas, four miles west of the Sublime pool. The new well is the company's No. 1 Underwood, Fuchs Survey, which is reported to have flowed at the rate of 1,000,000 cu ft of gas daily through a ¼-in. choke plus 75 bbl of 55.6 gravity condensate from 9685 to 9690 ft. Total depth of the well was 10,960 ft.

Wildcat Set for 13,500 Ft

A 13,500 ft wildcat has been staked in Lea County, New Mexico, by General American Oil Company of Texas. The new well is to be the No. 1 Harper-Federal, and will be drilled in the east side of the Delaware Basin, just off the west side of the Central Basin platform. Closest Ellenburger production is 15 miles east of the projected wildcat.

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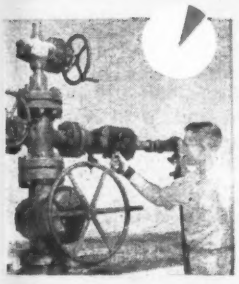
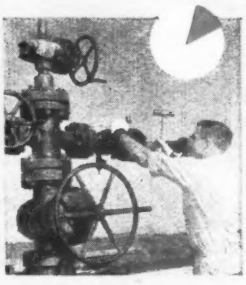
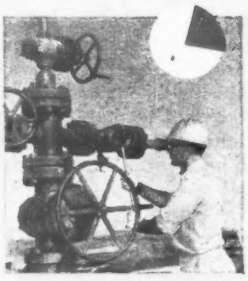


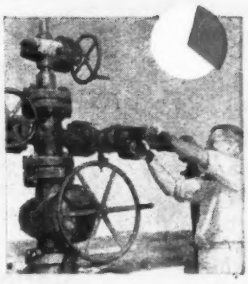
1&2 Bleeding pressure out of valve (top) and out of packing gland (above).



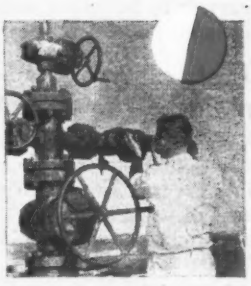
3 Removing bonnet clamp ring.



4 Removing bonnet seal ring.

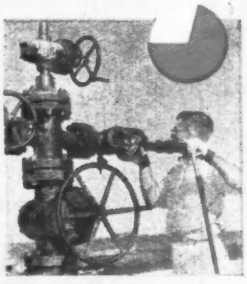


5 Removing bonnet, gate and segment.



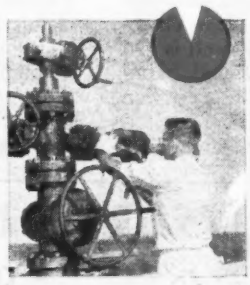
6 Breaking seals loose.

7 Removing worn seals.



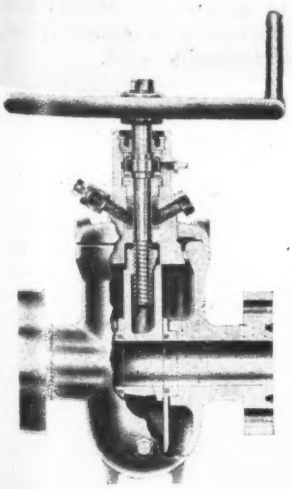
8 Installing new seals.

9 Installing new gate and segment.



10 Replacing stem, bonnet and bonnet seal ring.

11 Replacing clamp ring and the job is done. Elapsed time: one hour.



● The above photographs illustrate how simple it is to overhaul a W-K-M Valve on the tree. When overhauled as shown, the valve becomes as good as new, ready for many more years of efficient trouble-free service.

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Two Fields Opened In Permian Basin

Two new oil fields have been opened recently in the Permian basin, in Iron County, West Texas. Humble Oil and Refining Company has discovered oil at its No. 1 Pearl Williams, three miles south of the Tankersley-Wolfcamp field. The well flowed 311 bbl of oil a day through a 9/16-in. choke from the Strawn zone at 7230-46 ft.

The other pool opener is Atlantic Refining Company's No. 1-B. Noelke, which flowed 21.71 bbl of oil from 7413-66 ft. Gas-oil ratio was 5800-1, through a ½-in. choke.

New Spraberry Well Found

Sohio Petroleum Company has announced a new Spraberry well in the Reagan County, West Texas, at its No. 1-A Cauble. On a 24-hour flow test on perforations from 7475-7505 ft, 223.24 bbl of 40 gravity oil was produced through ½-in. choke. The upper Spraberry is to be tested before completion is made.

Light Oil Prospect Seen In Saskatchewan Area

Woodley Petroleum Company has reported that prospects of the first possible production of light oil in the Province of Saskatchewan, Canada, have been found at Socony-Vacuum-Western Prairie Exploration No. 7 Rosemary. The new well is in the Moose Jaw Suncline in the southern part of the province.

A drillstem test was taken at 3070-3100 ft recovered 3070 ft of clean oil between 26 and 30 gravity. The well is 100 miles north of the international boundary and 80 miles east of the west line of Saskatchewan. Western Prairie is a subsidiary of Woodley Petroleum.

Sunray Gets New Distillate Field

What appears to be an important multi-zone gas distillate wildcat discovery in Acadia Parish, Louisiana, has been discovered by Sunray Oil Corporation. Sunray reported two sands with approximately 20 net feet of saturation each and a sand with 30 net feet of saturation, all in the Hackberry section, 10,647-11,186 ft. The well, Sunray's Fred Loewer No. 1, is some five miles northeast of the North Crowley field and three miles northwest from the Branch field. The well is in the process of being completed in the lower of the three zones at 11,149-11,186 ft.

Thick Gas Cap Discovered In Canadian Gas Well

The thickest D3 formation gas cap in Canada has been discovered by Texaco Exploration Company. The new well, which may well prove to be one of the country's largest gas wells, was bottomed at 6697 ft and so far has penetrated more than 300 ft of D3, all of it gas cap. Latest drillstem test gave a gas flow at a rate of nearly 11,000,000 cu ft daily. The drillstem test and the gas cap were described as "phenomenal" by a Texaco official. Actual potential of the well would be several times the drillstem flow.

Sinclair Well Completed

Sinclair Oil and Gas Company recently opened a new oil field on the north bank of the Red River with completion of its No. 1 Evans in Love County, Oklahoma. The new well swabbed and flowed 215 bbl of oil in 20 hours from a sand zone at 4190-98 ft, after getting salt water at 4197-4237 ft in the Strawn sand that produces on the Texas side.

Gigantic Gas Field Seen In Ohio, West Virginia

A new gas field may be in the makin for Ohio. If indications prove correct th new field is of sizable proportions. Fir signs of the field were seen last fal when the B. H. Putnam 1 Wilson in Athens County gaged 2,300,000 cu ft of gas from a depth of 4222 ft, after shoo ing in the Devonian-Oriskany sandston A second well was drilled, the Putnam 1 Lamp in Washington County, and completed and gaged 6,000,000 cu ft of gas from the Oriskany at 4080-4116 ft. The No. 2 Wilson, completed toward the end of October, gaged 5,500,000 cu ft.

Twenty miles northeast of the first two wells, the Putnam 1 Arnold was completed recently, making 650,000 cu ft of gas natural at 4399 ft. The well is now standing.

Latest evidence of a major field appeared in the last few weeks when the Roy Proffitt 1 Fleming in Meigs County, about 12 miles south of the discovery wells, was completed in the Oriskany at 4223-30 ft for a small 100,000 cu ft gas well.

Engineers of the Putnam Oil Company have reported that should the entire area be proved the field would cover approximately 40,000 acres. They added it would be a 2-state pool with production in both Ohio and West Virginia. Gas reserves are unknown but estimated to be up to 250,000,000,000 cu ft.

Nebraska Gets 2-Zone Well

A multiple-zone discovery has been indicated at Ohio Oil Company's No. 1 Kugler in Cheyenne County, Nebraska. Casing is being run to total depth of 4628 ft. On test of the First Dakota zone at 4385-90 ft, the wildcat tested 3,365,000 cu ft of gas a day and recovered 30 ft of condensate. On test of the Third Dakota at 4530-75 ft, there was additional gas and condensate.

Olson Oil Opens New Pool In Oklahoma County

Opening Oklahoma's first oil pool of the year, is Olson Oil Company, organized December 1, 1951, at its No. 2 Erle Deacon "A", in Lincoln county. The new well flowed oil at an estimated rate of 25 bbl an hour on drill stem test from sand between 3280-3300 ft. Gas showed in 14 minutes and the oil flow reached the surface in 28 minutes. Flow is from the Bartlesville sand.

Wichita River Oil Merges With Oil Exploration

The Wichita River Oil Corporation of Virginia and Oil Exploration Company of Delaware have merged, with Wichita being the surviving corporation. Under the agreement, Wichita River Oil shareholders will receive three shares of the new company for each present share, while Oil Exploration stockholders will receive one share of the new company for each present share.

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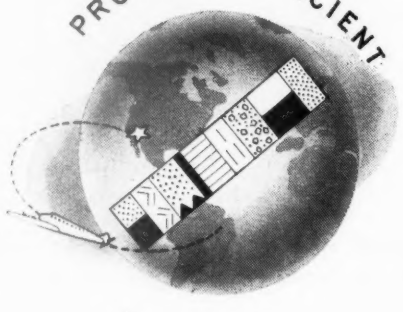

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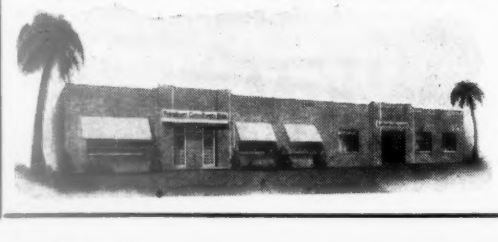

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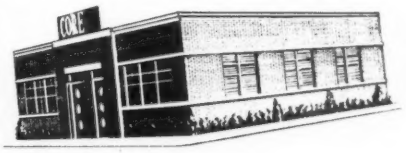
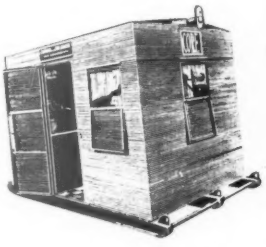
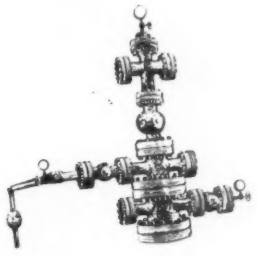


OFF-LOCATION CORE ANALYSIS

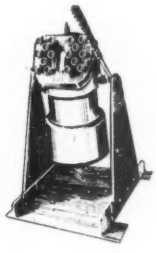
WELL LOGGING (on-shore)



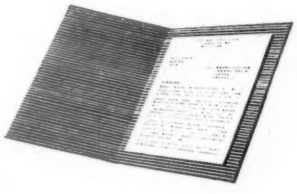
WELL LOGGING (off-shore)



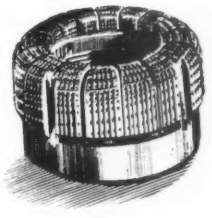
WELL SAMPLING



RESERVOIR FLUID ANALYSIS



ENGINEERING STUDIES



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Alabama Has Signs of Shallow Gas Production

Northwestern Alabama has indications of shallow gas production at D. E. Loversidge and Owen Health's No. 1 W. H. McKinney in Franklin County. The well blew out January 1, with cuttings from the well reportedly blown some 70 ft into the air. Flow was through 8⅝ in. pipe, which earlier had been set at 90 ft. The gas is coming from a 9-ft section of porosity at 374-82 ft in the St. Genevieve limestone of the Gasper formation, and hole was bottomed at 384 ft. The flow of gas, though not thought large, was sufficient to burn a flare some 20 ft in height. Commercial possibilities, however, are indicated because of the shallowness of the producing zone plus the nearness of Texas Eastern Transmission Corporation's line about 2 miles from the well.

Oil Flows From Deep Zone In Woodley Petroleum Well

Woodley Petroleum Company has indications of a good oil discovery from a new deep producing formation in Houston County, Texas. The discovery well, the Woodley and others' No. 1 W. T. Bruton Estate is flowing and cleaning oil from a 66-ft open hole section, in the Georgetown Limestone at 9164 to 9230 ft. Total depth of the well is 10,038 ft.

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S12-2

Continental Oil Finds Two Successful Kansas Wells

Continental Oil Company has reported success at 2 wildcat wells in Decatur County, Kansas. The wells are 2 miles apart 2 and 4 miles from the Adell pool, discovered by Continental in 1944.

The George Gillispie No. 1 swabbed 70 bbl of oil in an hour on a four-hour test, or at the daily rate of 1680 bbl. Flow was from perforations in the Lansing lime at 3664-86 ft. Additional tests are being made.

Two miles to the north, in the Jennings area, the J. E. Hardesty No. 1 recovered 2190 ft of oil in an hour, on a drill stem test in the Lansing lime at 3672-84 ft.

Magnolia Sets New Depth In Louisiana Wildcat

A new depth record has been set in South Louisiana at Magnolia Petroleum Company's No. 1-D Ragley Lumber Company, Allen Parish. The well is projected to 18,000 ft, and at the present time is drilling below 17,172 ft. Placid Oil Company was former holder of the record, set at 16,237 ft in 1950 at its No. 1 City of New Orleans, Lafourche Parish.

Arkansas Pool Indicated

Reynolds Gammill Lumber Company's No. 1 in Union County, Arkansas, has prospects of being a new deep pool opener. The well is about halfway between the Lisbon and Bear Creek fields. On a drillstem test from 6423-30 ft, 226 ft of oil and no water were yielded. Gas came to the surface in five minutes. The 30-minute test was made on a ¼-in. top and ⅜-in. bottom chokes. On a second drillstem test at 6424-75 ft, recovery was 520 ft of oil; 200 ft water.

Gulf Opens Field in Wilkinson, Mississippi

The Ireland field in Wilkinson County, Mississippi, was opened recently by Gulf Refining Company. The well was given a potential flow of 151 bbl of 38 gravity oil per day through a ⅛-in. choke with tubing pressure of 555 lb. Flow was cut with 1.5 per cent basic sediment and water. Gas-oil ratio is 292-1. Flow is from casing perforations placed opposite the sand section at 6733-40 ft.

Flynn Well on Pump

The new discovery in Beaver County, Oklahoma, drilled by Flynn Oil Company, has been placed on pump for production tests. The company's No. 1 School Land made 10 to 12 bbl of oil per hour (pump capacity) in the first 12 hours. When it was opened before rods were run and after it had been standing for several weeks, the well flowed for 10 hours, putting 166 bbl of oil in the tanks. Flow is through ⅛ and ¼ in. chokes.

GEOLOGISTS FORESEE ATOMIC ENERGY AS INDUSTRIALLY UNIMPORTANT

Despite continuing depletion of our mineral resources, substantial industrial use of atomic energy in the next 50 years is considered to be relatively improbable, it was revealed through a survey conducted by the American Geological Institute among leading U. S. geologists in industry, educational and research agencies.

Full employment for all members of the geological profession and increasing shortages of qualified geological scientists is foreseen for 1952. Geological and geophysical work utilizing new and more refined research and exploratory techniques in the search for mineral resources to provide the mineral basis of U. S. prosperity and defense on a continuing and adequate scale will be constantly accelerated. The enhanced demand for minerals, including fuels, and consequent depletion of readily available supplies, will also require much more detailed and exhaustive geological work on a more extensive scale than ever attempted before. The coming year should therefore set a new high in all phases of scientific geological activity in the United States, and will see increasing numbers of U. S. geologists utilized in foreign areas calculated to yield useful mineral deposits.

Leading geologists also anticipate that additional applications of geological and geophysical techniques to all phases of the search for minerals and underground water supplies, to the construction industry and to basic agricultural problems will be made with increasing intensity during the next few years. This will lead to at least a two-fold increase in the number of earth scientists, now about 15,000, in the forseeable future.

The experts also suggest that by the year 2000 most of our industrial power will be derived from treatment of oil shale and coal, supplemented by water power, solar energy and atomic energy. They foresee extensive use of new lightweight metals such as titanium, and others which today are unusable because they cannot be extracted from the earth in acceptable quantities.

There is almost unanimous agreement that by 1975 direct production of natural petroleum will be past its peak and importations from foreign sources will be insufficient to meet our domestic needs. Yet a constantly increasing demand for petroliferous products is envisaged. Liquid fuels from the large oil shale deposits of the Colorado Pleateau and the low-grade coals of the Mid-West and Plains areas will supplement the declining supplies of natural petroleum. More water power will be used, but the proportion in relation to the national energy demands will probably be no greater than today. The use of powdered coal to replace industrial fuel oil and increased use of coal as petroleum deposits are depleted, should double coal production within 25 or 30 years. Most of this increase will be used in liquid or gaseous form rather than in the solid form to which we are accustomed.

Max W. Ball, well-known geologist of Washington, D. C., foresees possible geochemical and electronic developments that will allow the location of oil and gas pools by direct methods, rather than indirectly as at present. Today research by geologists and geophysicists locates areas where the gelogical conditions are favorable for oil and gas accumulation, but an expensive well must be drilled before we know definitely that the oil or gas are actually present.

Within the next 25 years, S. G. Lasky of the U. S. Geological Survey anticipates the production of supplementary supplies of oil and gas from the controlled burning of underground coal seams, in much the same way as is being done experimentally today in Alabama. By the year 2000 he expects us to be utilizing our energy sources much more efficiently than at present, using new methods and devices not as yet fully visualized. He also suggests that these new methods may relieve the pressure for more and more new discoveries of natural petroleum.

Domestic petroleum production will be well past its peak by 1975 in the opinion of Eugene Ayres of the Gulf Research and Development Corporation and we will probably be unable to make up the deficit through importation of oil from abroad. This will force the United States to turn to large scale production of oil from shale and coal, and by the year 2000 these will yield most of our domestic supply. By that date, however, heat and power from solar energy should reach a substantial figure and assist materially in making up any deficit in heat and power supplies.

These views are shared in general by M. M. Leighton, Chief of the Illinois State Geological Survey, who also suggests the possibility that some energy may be developed by 2000 A. D. through the use of photosynthetic processes.

But a cheering note is sounded by Wallace E. Pratt, former vice president of the Standard Oil Company of New Jersey. He points out optimistically that if we had never possessed large coal and petroleum resources in the United States we might have gone directly to the use of solar energy generations ago, and thus have had available more energy than has been supplied through the use of fossil fuels.

Husky-Wilshire Opens New Area in Wyoming

A joint venture by the Husky Oil Company and the Wilshire Oil Company in the Five Mile area of Big Horn County, Wyoming, about 14 miles northwest of Worland, has produced a wildcat strike of major proportions in the previously untested deeper formations of the Big Horn basin. The entire basin is now believed by many to be one of the greatest potential producing areas in Wyoming.

The wildcat, Torgeson No. 1, is coring below 11,863 ft and is an estimated 70 ft above Tensleep at this depth. About 86 ft of producing zone has been established in the Embar, topped at 11,645 ft with a gas potential estimated to be as high as 20,000,000 cu ft per day. Potential as to oil in this discovery well is yet unknown although some high gravity oil has been recovered on tests of the formation. Recovery of sour gas from the well has a sulfur dioxide content in excess of 14 per cent, which is calculated to yield 6.6 tons per 1,000,000 cu ft of production.

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Running tour with men in the industry

Bart W. Gillespie has been named manager of The British American Oil Company, Ltd., exploration and production departments in Canada. He succeeds James J. Statler who has resigned. A geology graduate of Stanford University, Gillespie served in the Engineer Corps of the U. S. Army during the First World War. After being discharged, he worked for a short period in Mexico before returning to California as core driller and superintendent of the Elliot Core Drilling Company. He was later appointed field manager for Cia. de Petroleo Ganza Azul, in Peru.

During the Second World War Gillespie served as a captain of the SeaBee's in the U. S. Navy, and was in charge of all naval exploration activities in the Arctic. He remained in Alaska after the war as project manager for Arctic Contractors Ltd., which was carrying on exploration and drilling activities for the navy. Before coming to British American, Gillespie was the general manager of the Mexican American Independent Company, in Mexico City.

E. L. Shafer, district superintendent of production for Continental Oil Company at Hobbs, New Mexico, has been appointed manager of production for Hudson's Bay Oil and Gas Company, Ltd., Continental's affiliate in Canada. The announcement was made by R. C. Brown, Calgary, Alberta, vice president and manager of the Canadian company.

A native of Oklahoma, Shafer received his B.S. degree in petroleum engineering from the New Mexico School of Mines and joined Continental in 1937 as a roustabout in North Texas. He has been in the Hobbs district assignment for the last two years, and plans to move to Calgary about March 1.

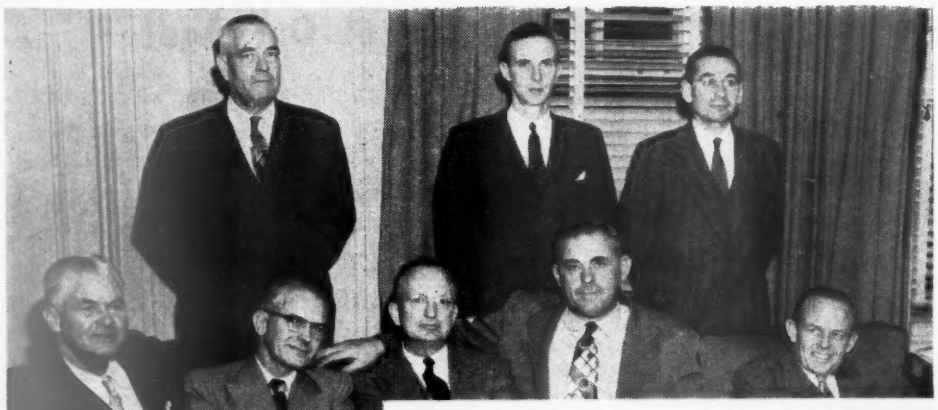
Ralph H. Hamblin, formerly geologist and manager of the Mattoon, Illinois, office of Transcontinental Oil Company, opened offices recently in Denver, Colorado, as consulting geologist. Prior to joining Transcontinental, Hamblin was district geologist for Cities Service Oil Company in Illinois, Indiana, and Kentucky.

Fred P. Schweers, district geologist at Ardmore, Oklahoma, for Skelly Oil Company, has resigned to join the Mercury Drilling Company at Tulsa. Later in the year, it has been announced, Schweers will head a new office in Oklahoma City for Skelly Oil.

Robert F. Williams has organized the Walters Drilling Company in Wichita, Kansas. Walters is president, **Allan Gilmour,** Chicago, Illinois, vice president and treasurer; **Emory S. Naylor,** Chicago, secretary, and **Lester L. Morris,** Wichita, assistant secretary.

John D. Fitch has been employed by Ebasco Services Incorporated as a member of its consulting engineering department, according to announcement by the firm. For the last nine years Fitch has been with the Export Import Bank, Washington, D. C., as principal engineer and chief of the engineering division. Following graduation from Massachusetts Institute of Technology in 1924 until his association with the Export Import Bank, he was employed as an hydraulic engineer by Minnesota Power and Light Company, Charles J. Main Incorporated, Charles B. Hawley Engineering Corporation, and the Federal Power Commission.

Joseph J. Rogers has been named drilling superintendent for Long Beach Oil Development Company. He succeeds **Frank J. Kightlinger** who has retired. Albert W. Gentry, supervisor of operations, made the announcement.



Foreign guests attending a Los Angeles Nomads meeting were: Below, seated, O. E. Harndin, Caltex; Arnaldo Rojas and Oscar Schneider, ENAP Corporacion de Fomento, Chile; L. J. Whitson, The Texas Company, Bogota, and C. R. "Buck" Devine, IPC Basrah, Iraq. Standing, Les Maupin, ex-KTO; C. W. Maupin, D & E, Brazil; Don Rowe, Servicis Thomas El Tigrito, Venezuela; Harry Simmons, A-Z Exports, S. A. Porto La Cruz, Venezuela; A. F. Driskill, Iraq Petroleum Company, and Mario Infante, ENAP.

Above, seated, Ray O. Whitney, ex-D & E, Brazil; Kent O. Garner, Santa Fe Drilling, Italy; Mike Bush, Southeastern de Mexico; W. C. Field, Richmond Exploration, Maracaibo, Venezuela, and Bob Battersly, Santa Fe Drilling, Italy. Standing, S. Paul Hart, Holmes & Narver, Marshall Islands; Robert Blackwood, Union Oil, Chile, and Salvada Ferradas, ENAP Corporacion, Chile.

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McCULLOUGH GLASS JET and BURRLESS BULLET PERFORATORS

PROBLEM	GUN USED and CASING SIZES	RESULT
*1. **Dominguez, California.** Well used to test results of Glass Jet charge in new size, small O.D. Solid Steel Perforator Body. Shots to be fired in well idle for over 15 years. Well to be abandoned after our tests.	Special small O.D. McCullough Solid Steel Perforator Body with Glass Jet charges. Casing sizes: 6⅝" 24 lb. and 8⅝" 36 lb. Formerly shot with competitive perforators without results.	Sixteen shots fired, one at a time. Rise in fluid level stopped test. On pump, well produced 135 B/D!
2. **Shreveport, Louisiana.** Well had been shot two times with competitive perforators without results.	McCullough Burrless Bullet and McCullough Glass Jet Perforator with Steel Strip Carrier. 24 shots with each. 4½" drill pipe. Sand formation.	After perforating bailer was run and when retrieved it was about ¾ full of oil. Time on job: one hour.
3. **Weesatche, Oklahoma.** Well only produced 3 B/D.	McCullough Glass Jet Perforator with Steel Strip Carrier. 12 holes shot through 6" casing. Sand formation.	60 B/D reported by oil operator after perforating.
4. **San Angelo, Texas.** Drill stem test: 400 feet of free oil.	McCullough Glass Jet Perforator with Steel Strip Carrier. 4¾" open hole. Strawn lime formation. 102 holes shot.	Steady flow of 50 B/D. Time on job: 3 hours.
5. **Cyril, Oklahoma.** New well.	McCullough Glass Jet Perforator with Steel Strip Carrier. 7" casing. Sand formation. 279 holes shot.	240 B/D. 12 runs due to broken zones. Time on job: 13 hours.
6. **Kettleman Hills, California.** New zone.	McCullough Burrless Bullets. 6⅝" casing. 300 holes shot.	250 B/D, an exceptionally good well for this area. Time on job: 5 hours.
7. **Oklahoma Wildcat.** New well.	McCullough Glass Jet Perforator with Steel Strip Carrier. 7" 20 lb. casing. Eight zones perforated with a total of 174 holes.	Production of 65 B/D much greater than anticipated. Time on job: 6½ hours.
8. **New Iberia, Louisiana.** New well.	McCullough Burrless Bullets. 6⅝" 32 lb. casing. Sand formation. 60 holes shot.	Production not released but Engineer reported a very good well. Time on job: 3 hours.
9. **Houston, Texas.** Salt water in the hole. Competitive tester made three runs but couldn't fire gun.	McCullough Gun Tester with Burrless Bullets. 5½" 17 lb. casing. 96 holes shot as ordered.	Satisfactory test job.
10. **Healdton, Oklahoma.** Well would not take acid.	McCullough Glass Jet Perforator with Steel Strip Carrier. 5½" 17 lb. casing. 90 holes shot. Sand formation.	70 B/D. Time on job: 5 hours.

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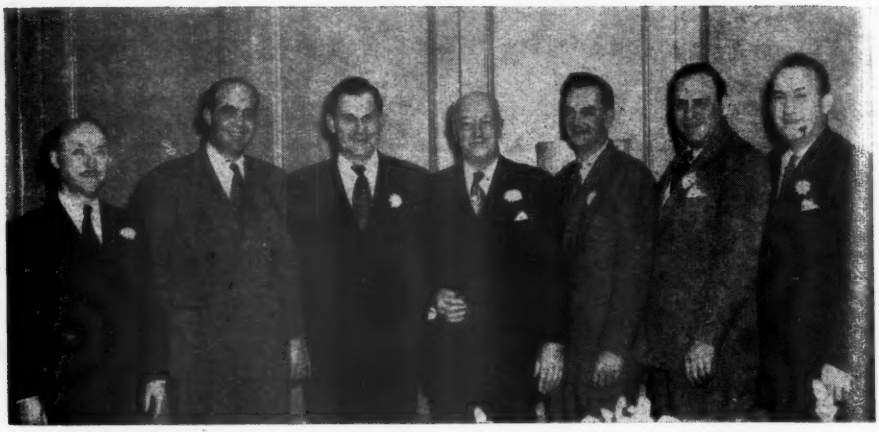
To obtain more information on products advertised see page E-41

Retiring President Howard B. Book presents the New York Chapter of Nomads' gavel to incoming President A. A. Dill.



New officers of New York chapter of Nomads.

▸ **A. A. Dill,** Axelson Manufacturing Company, has been named president of the New York Nomads during 1952. Shown in the accompanying photo, are other new officers: **Howard B. Book,** Reed Roller Bit Company, retiring president, regent; **Jesse E. Hickman,** Beckley, Haltom and Hickman, secretary; **Russ V. McIntire,** Baker Oil Tools, vice president; Dill; **C. P. McDonald,** Parkersburg Rig and Reel Company, sergeant-at-arms; **Edmund Burke, Jr.,** General Motors Overseas Operations, assistant sergeant-at-arms; **O. B. Latrobe,** Hughes Tool Company, assistant secretary. Other officers not shown are **E. R. Smoley,** The Lummus Company, treasurer; **Don E. Kircher,** Gardner-Denver Company, assistant treasurer, and **Henry J. McAdams,** Jones and Laughlin Supply, regent.

▸ **L. B. Jerrers,** formerly proration engineer for the Barnsdall Oil Company and Sunray Oil Corporation, has been named manager of the Salmon Oil Company's new primary production division. **George B. Allen** is the new manager of secondary recovery operations. The Salmon interests of New York formed the Salmon Oil Company in 1951. Expansion of its oil and gas activities was announced by Walter J. Salmon.

▸ **T. H. Marshall,** Oklahoma City, has been elected president of the Kansas-Oklahoma division of Mid-Continent Oil and Gas Association. He succeeds **W. T. Payne,** who heads the general association. Marshall retired recently as vice president of Anderson Prichard.

▸ **Robert N. Williams,** consulting geologist of Santa Barbara, California, has become chief geologist of Coronet Oil Company. Coronet Oil developed production in the Andector field of West Texas and has other holdings in Wyoming, Montana, New Mexico and Texas. Williams will make his headquarters in Midland, Texas.

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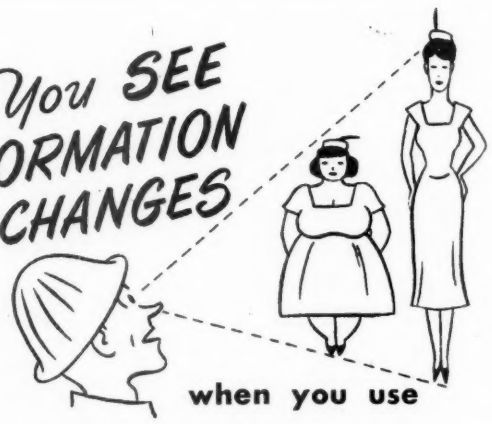

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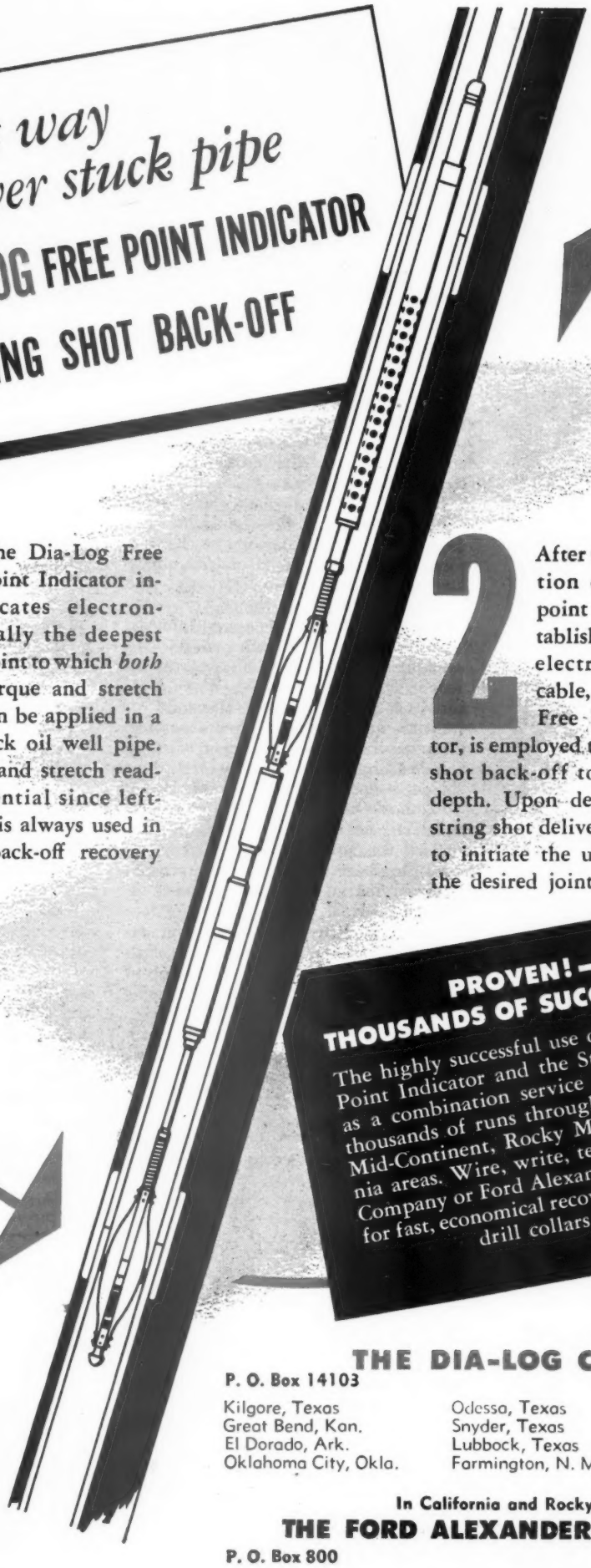

1 The Dia-Log Free Point Indicator indicates electronically the deepest point to which *both* torque and stretch can be applied in a string of stuck oil well pipe. Both torque and stretch readings are essential since left-hand torque is always used in subsequent back-off recovery operations.

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Harry Dereniuk has been promoted to chief primary engineer of Deep Rock Oil Corporation. He was formerly district engineer in the company's Wichita Falls, Texas, office. In his new assignment, Dereniuk will be in the Tulsa general office. Dereniuk is a native of Saskatchewan, Canada, and a petroleum engineering graduate of the University of Oklahoma. Before joining Deep Rock he was in charge of the engineering department of a Southwestern gas company. Dereniuk has had considerable field experience in Texas, Kansas, and Canada.

T. F. Lawry has accepted a position with the Kewanee Oil Company as Illinois division engineer with headquarters in Robinson, Illinois. Following his graduation from the University of Pittsburgh in 1935, Lawry has had a wide and diversified experience in the recovery of oil by the waterflood process. In sequence he has held positions with Forest Oil Company, Ohio Oil Company, Sohio Oil Company, and Deep Rock Oil Corporation where his services were utilized in the analysis and interpretation of cores, evaluation and acquirement of potential flood acreage, installation of flood projects and supervision of secondary recovery ventures.

Prior to his employment by the Kewanee Oil Company, Lawry retained the position of chief secondary recovery engineer of the several flood projects operated by the Deep Rock.

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Harry Dereniuk

T. W. Nelson

D. H. Clewell

C. F. Stephenson, former district superintendent of Magnolia Petroleum Company's Shreveport, Louisiana district, has been transferred to the newly created Pegasus district with headquarters at Midland, Texas.

H. V. Harden, who has been district superintendent of the Louisiana-Gulf district with headquarters at Morgan City, was transferred to district superintendent of the Shreveport district with headquarters at Shreveport.

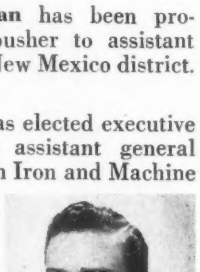
Miller L. Ekas has been made general superintendent of machine shops with headquarters at Magnolia's general offices in Dallas. He replaces **W. C. Morgan** who retired from the Magnolia organization after nearly 40 years' service. Ekas has been superintendent of Magnolia's Kermit machine shop. His place there has been taken by **Jay M. Hahn.**

Leonard O. Franklin, formerly petroleum engineer in Magnolia's Kermit district, was promoted to district petroleum engineer in the newly created Pegasus district with headquarters at Midland, Texas.

Ernest B. Etheridge, petroleum engineering assistant in Magnolia's Falfurrias district, has been promoted to assistant foreman in the company's Shreveport district.

George A. Harman has been promoted from gang pusher to assistant foreman in the Lea, New Mexico district.

Elmer E. Rubac was elected executive vice president and assistant general manager of American Iron and Machine Works Company recently. Rubac has been with American Iron since 1937, with the exception of three years when he was on military leave of absence. For the past two years he has held office as vice president of the company.



Elmer E. Rubac

Others elected as officers and members of the board of directors are as follows: **J. A. Gray,** chairman of the board; **M. G. McCool,** president and general manager; **Cecil N. Cook,** vice president; **V. L. Thomas,** secretary and treasurer, and **A. J. Parfel,** assistant secretary.

T. W. Nelson has been named associate director of Socony-Vacuum's laboratories, J. L. Latimer, president of Magnolia Petroleum Company, a Socony-Vacuum affiliate, announced. The appointment is to be effective March 1st.

Nelson has been director of Magnolia's field research laboratories at Dallas for the last six years. He will make his headquarters in New York. Research at the Dallas laboratories is devoted exclusively to world-wide exploration and production problems.

Nelson was graduated from the Colorado School of Mines in 1934 with a degree in petroleum engineering. That year he began work in the technical department of Socony-Vacuum's refinery at Augusta, Kansas. He later became director of the Dallas laboratories.

Nelson will be succeeded at Magnolia's field research laboratories in Dallas by **Dr. Dayton H. Clewell,** assistant director. Dr. Clewell, who received his doctorate degree in physics from Massachusetts Institute of Technology, joined Magnolia in 1938 as a research geophysicist. In 1946 he became assistant director of the laboratories. He also served as supervisor, exploration research, field research laboratories.

John F. Hills, Derby Oil Company, has been named president of the Kansas Oil Scouts association, succeeding **Ted B. Jennings,** Magnolia Petroleum Company. Other officers are: **Carl M. Bomholt,** Phillips Petroleum, and **W. F. Ellis,** Shell Oil, vice presidents, and **Robert E. Sink,** of Carter Oil, secretary-treasurer.

DEATHS

I. T. "Cad" Cadwell, 65, retired drilling superintendent with The Texas Company and a pioneer with almost 50 years of service in practically every oil field in California, died at his home in Long Beach, California, December 18, 1951, of a heart ailment. In the earlier days Cadwell was a wildcatter; later, at one time or another, working as a driller or drilling foreman with practically every major oil company in this state prior to joining The Texas Company in 1926. As a pioneer cable tool driller, Cadwell helped bring in discovery wells in the Orcutt, Los Alamos, Cat Canyon, and Casmalia fields, the hard way.

Microscopes and Greases

ARCH L. FOSTER*

Photo Courtesy Universal Oil Products Co.

The electron microscope is analogous to the ordinary optical microscope; it uses a stream of electrons from a "gun" as "light," condensing and objective "lenses" and a camera. These lenses are magnetic coils. This instrument opens up a new world, making visible objects only one-one hundredth the size of the smallest visible under the optical microscope.

In no phase of refining technology has progress in methods, techniques, and in findings of importance progressed more rapidly than in the study of the structure and behavior of lubricating greases. Since the early dawn of lubrication with petroleum products as bases, greasemakers have mixed soaps of fatty and similar acids with lubricating oil fractions to make lubricants that will stay put in locations where liquids will run quickly off and away from the surfaces to be lubricated.

This business is and has been an art rather than a science. The problem of finding out the Why of oil's remaining mixed with the soaps, what happens when a grease is mixed, what reactions of primary or of secondary valence combinations, or of no valence reactions at all between oil and soap, has seemed until very recent times an impossible task. Greasemakers appeared to know from texture, visual appearance, the plop of the mix as steam bubbles were freed, or from the phase of the moon just when the proportions were correct, when the batch had been heated and stirred enough. Young men learned the art from old heads, from much watching and from "cut and try". Greasemaking has been and, in manufacture still is, largely a guild secret reminiscent of the Middle Ages, apparently incapable of explanation in scientific or engineering terms.

As of the last 10 years the art is fast becoming a science. Much of this has been accomplished by empirical, cut-and-try methods by which the most reasonable explanation of any phenomenon was arrived at by a process of elimination. More recently the introduction of that all-seeing eye, the electron microscope, and the attendant techniques is expanding knowledge of grease structures and the effects of various manufacturing methods on grease properties.

One of the major fields being explored with this microscope is that of crystal structure of soaps and the matrix of crystals formed in greases. Of this property Bondi and collaborators say, regarding soda base greases, "The fibers form a brush-heap structure, within whose interstices the oil is held by capillary forces". This, if true as the evidence appears to support, explains in part why a properly made grease 'bleeds' only slightly if at all at room temperatures; capillary forces are stronger than those of gravity. (A. Bondi, et al, "Soda Base Greases", NLGI, October, 1951). Of the difficulties of reducing greasemaking to an entirely scientific basis it is said that empirical selection of raw materials and processes will no doubt continue to be the important route to future grease developments "but that progress is helped by a knowledge of soap-base grease structure."

It has been found that the crystal structure of soaps of different chemical composition vary greatly, and this fact accounts for much of the differences between greases made from different soaps. For example, resistance to deformation displayed by the "brush heap" increases as the fiber length increases; the stability of greases is dependent largely on the relative tendencies of the fibers to break up into shorter pieces that reduce consistency, or to split into thinner pieces, which increases consistency. That is, the ratio of length to thickness of fibers is a controlling factor in grease consistency.

This structure in calcium-base greases is referred to as "The existence of an irregular, mesh-like soap structure," and data have been shown to prove also the relationship between this structure and the "consistency and stability of the system". (Vold, Coffer and Baker, "Structure of Gels of Hydrous Calcium Stearate, Etc., NLGI, October, 1951). One of the more desirable investigations is said to be the determination of whether or not this phenomenon is typical of other greases, as well as study of the effect of working, rate of cooling, and other manufacturing variables on grease properties. Calcium stearate soaps are found, in cetane or hexadecane, $C_{16}H_{34}$ (hydrocarbon in diesel fuel range) not to have so fibrous a "habit" as has calcium tallow soaps, composed of soaps of stearic and some other fatty acids such as oleic and palmitic. The primary structure of soaps is referred to as "disordered crystallites"; one of the important subjects of study is said also to be the secondary structures built up from the "primary particles" of soap.

Much attention is being given to the methods for preparation of electron microscope samples. The question of the effect of such methods on the appearance of the samples, the "facts" revealed by the microscope, and of whether or not the finished samples show the same structures and conditions as obtained in the original grease has not been answered satisfactorily as yet. In one case calcium stearate monohydrate in cetane was smeared on glass slides, the cetane leached out with benzene, and remains of solvent evaporated at room temperature as well as at lower temperatures down to minus 180 F. Soap samples so prepared show "discrete agglomerates of irregularly shaped particles", while genuine fibers do not appear in this system. Samples in which the cetane is evaporated under vacuum, directly without use of a solvent, show more agglomeration than do those extracted, causing the researchers to decide that extraction disperses the particles, and thus should not be used, as the process tends to destroy any secondary particle structures that may be important to the grease properties.

One method of preparing slides is by freezing a block of soap-grease gel and slicing it into sections of thickness from 0.05 to 0.1 u (mu) or 0.000003-in. Another method is to cover a specimen screen with a type of plastic (formvar). A portion of grease is agitated in ASTM naphtha, a drop or two placed on the film, dried and washed with naphtha, and a thin film of heavy metal is evaporated on the slide "at an angle" (shadow-casting) so that contrast will be shown on the slide under the microscope. (J. A. Brown et al, NLGI, October, 1951.) These investigators believe this method, using a solvent and dispersion of sample therein, to be "a legitimate one and that fiber structure revealed by the electron microscope is the true structure". Slic-

*Editor, Refining and Gas Processing.

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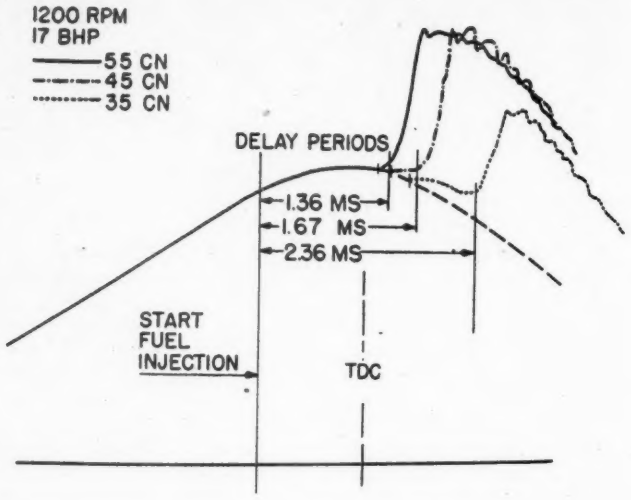
ing techniques are typified by that in which a sample is frozen, sliced by the microtome to essentially the required thickness, floating the slices away from the cutting blade in a cooled water trough, collecting them on collodion-coated screens, vacuum evaporating the cetane, and photomicrographing. (Vold, et al). It is not certain that this method shows the original structure but is believed that the original is a structure similar or of more intricate organization. Brown found that a thin film of grease spread on a support and shadowed without use of naphtha in any manner shows essentially the same structure as is shown by the method of preparation outlined above using naphtha dispersion and washing. Therefore it is concluded that the naphtha-dispersed sample is practically identical with the original. This study was made on lithium-soap greases, which showed a definite and marked crystal structure of fibrous, thread-like proportions.



Effect of cetane number of low-load combustion—increased displacement of jagged part of curve indicates increasingly poorer ignition.

Diesel Fuel Ignition Research

Tremendous growth in the use of diesel engines for more and more purposes, especially in automotive and similar high-speed diesels, combined with changing trends in market demands for other products all have combined to pose a serious problem to the refiner in how to make what for which. Slow-speed diesels are not choosy as to fuels, due to the inherent nature of the diesel cycle. When the principle came to be applied to higher speeds of revolution, the quality of fuel assumed increasing importance, especially as applied to ignition quality.

In years past it has been feasible to choose from the crude barrel the specific fraction that gives the best diesel operation, as competition in the refinery and the market for those fractions was less keen, and because the relatively very small percentage of the barrel required to meet total market demands made little difference to the industry.

In recent years trucks, tractors, buses, etc., have been converted to or designed for diesel engine power in rapidly increasing numbers, mainly for reasons of economy. This cut deeper into the diesel fuel-gas oil fraction of crude. Simultaneously domestic and industrial heating installations increased very rapidly in numbers, draining further quantities from this fraction. The total quantity of this fraction available at any given time did not increase nearly as rapidly as did the demand for it. Still more insistent has been the increase of catalytic cracking, with continuation of thermal cracking requirements for this same fraction.

Catalytic cracking especially produces relatively large quantities of cycle oil or fractions of the boiling range of straightrun gas oil or diesel oil fuels. These fractions are fairly satisfactory for domestic and similar distillate heating oils, especially when blended with a portion of straightrun oil. They are more refractory than straightrun charge stocks for catalytic cracking, and have been produced by one or more passes through the catalytic system, but can be used as recycle stock. They show fairly good properties for diesel fuel use, including especially the "property" of lower price, but ignition quality is normally unsatisfactory.

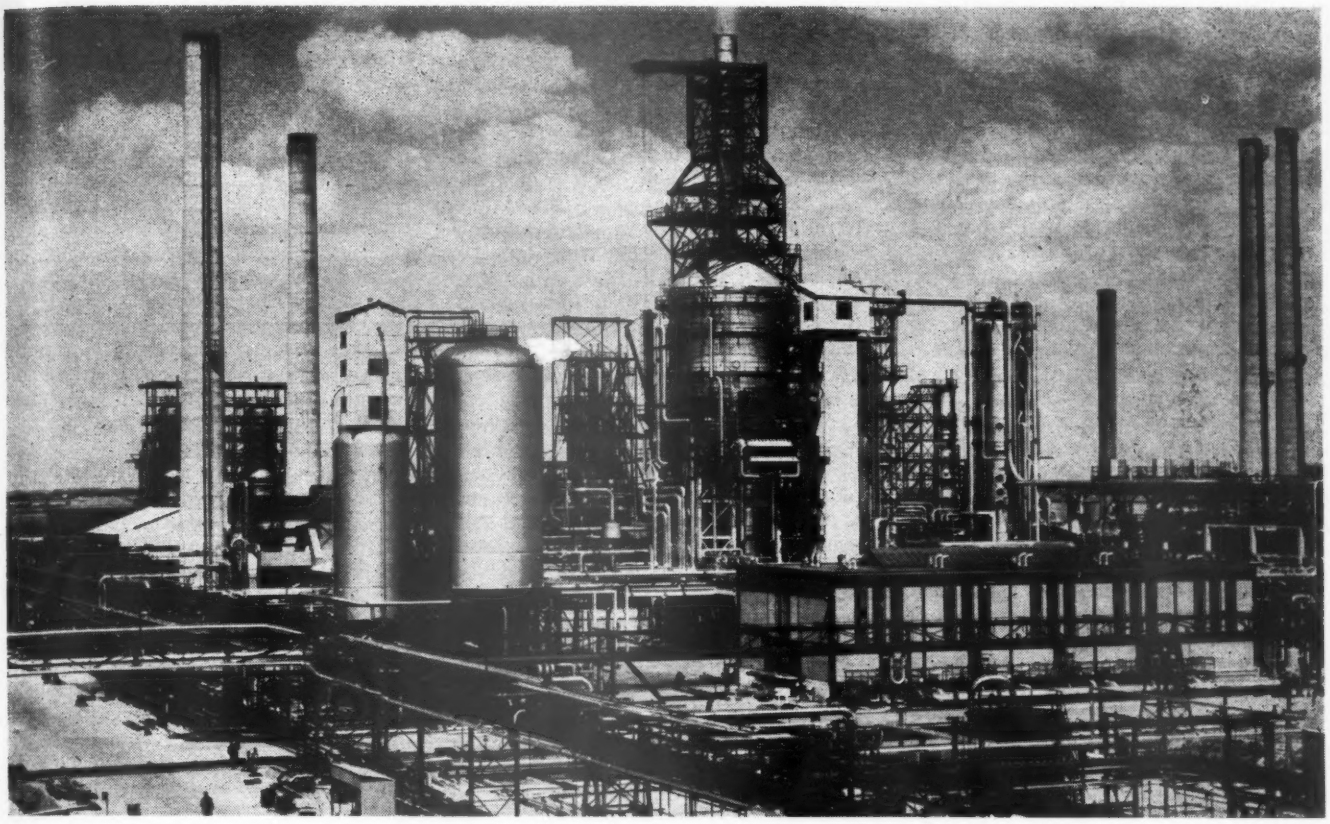
Two major methods are coming into use for making these cycle stocks suitable for diesel fuels. In recent months announcement has been made of the construction of units for the improvement of such stocks for diesel fuel use by selective solvent extraction treatments, analogous to solvent extraction of lubricating oils. By such means the raffinate is improved progressively by concentration of paraffinic constituents and the accompanying rejection of olefinic, napthenic, aromatic and other less saturated constituents as extract. The paraffinic hydrocarbons show better ignition quality, that is, less ignition delay, than do the other main components of the fraction mentioned.

A second method for improving ignition quality is that of addition of small percentages of ignition improvers, such as organic nitrites and nitrates, sulfur, various other nitrogen organics, ethers, etc. These materials reduce the period of delay between the time of initial fuel injection and the time when the fuel starts to burn. Due to the nature of diesel fuel combustion conditions, exhaustive research has shown that the overall, governing cetane number requirements for diesel fuels is determined by the engine's needs for low-load, low-speed operations. Less irregularity in burning is found at high speeds and loads, when much more residual heat is retained in the combustion chamber.

Cetane number is the ASTM designation of ignition delay period of an unknown fuel tested in a special engine under strictly specified and controlled conditions, bracketing it between the values of two known fuels at a fixed ignition-delay period. This determines the location of a point on a three-dimensional diagram where this delay is plotted against temperature and pressure.

Cracked fuels, available in larger quantities for diesel fuel at lower cost, have a lower pour point than straightrun fuel from the same crude. Also, they have greater heat value per gallon, both advantages in diesels. But they have poorer ignition delay properties, which calls for either removal of the objectionable components as with selective solvents, or by addition of a special "catalyst" or ignition improver. One of the recent addition agents for diesel fuels to reach commercial importance is amyl nitrate, which reduces ignition delay period strongly when added in minute quantities.

The degree of improvement shown by the use of one per cent of the nitrate in various fuels of differing compositions varies with the initial cetane number and the nature of the fraction. Briefly, the higher the initial cetane number the greater the degree of improvement. The boost in cetane rating ranged, in one set of exhaustive tests (M. J. Anderson-G. C. Wilson, Ethyl Corporation, SAE, October, 1951), ranges from 10.3 in a fuel showing 26.4 initial or "clear" cetane rating, to 17.2 in a fuel with a 50 initial rating. As a gain of five or more cetane units is desirable for an appreciable increase in ignition quality, this nitrate shows to advantage, in that one-eighth to one-fourth of one per cent is adequate on typical fuels to give the increase in rating required to show definite advantage in engine operation. This small quantity needed is a large part of the problem; of more than 300 compounds tested nearly all were ruled out because of the high cost per cetane number improvement. * * *



First European cat-cracker in Europe is this one, Shell's refinery at Pernis, near Rotterdam.

Refineries go on Stream in Western Europe

The Netherlands, Belgium, and Great Britain each have recent modern plants to expand their domestic processing facilities

V. S. SWAMINATHAN

PERNIS REFINERY

WITH the erection of Europe's first modern type catalytic cracker, with a capacity of about 1,250,000 tons (9,475.-000 bbl of 36 API) per annum, Shell's post-war program at Pernis near Rotterdam in Holland, inaugurated in 1945 and, involving an outlay of some £20 million ($56,000,000), has been completed. Pernis refinery is now the largest in Europe. War damage repairs brought its capacity in 1946 back to the pre-war level of 1,000,000 tons a year, and subsequent expansion has raised the figure to 5,000,000 tons per annum. These new extensions form part of Shell's overall post-war refinery expansion program, which, including installations in France, Germany, and Italy, has now made the company by far the largest refinery operator in Europe with a total yearly capacity of approximately 20,000,000 tons (153,000,000 bbl).

The total area of the Pernis refinery is 900 acres, 550 acres of which are built-up. Its aggregate water front, including tank farms, covers 3½ miles. The storage capacity amounts to 1,200,-000 tons. Altogether there are 19 jetties for tankers, coasters, and tank lighters. Seven tankers, including the modern 28,000-ton super tankers, can berth at the same time. The total discharging capacity is 6000 cu metres per hour. Daily consumption of the refinery is fuel gas 450,000 cu meters, fuel oil 500 tons, steam 4500 tons, and electricity 200,000 kwh.

For the primary processing of crude oil, obtained from the domestic Schoonebeck field and the Middle East, Pernis refinery has three distillation units, which now have a throughput of approximately 12,000 tons a day (about 90,000 bbl per day). There are, in addition, two high-vacuum installations, one of which is for processing asphaltic residues into asphalt, and in the other waxy distillates are distilled off from wax residues. The waxy distillates are dewaxed in a solvent dewaxing unit. A portion of these distillates is then purified with sulfuric acid and clay in a dry refining plant. The refined lubricating oils are mainly dispatched packed, a filling plant having been installed for this purpose.

The slack wax obtained during the dewaxing process is cracked in two vapor-phase cracking units. From the cracked distillate so obtained a fraction

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is separated off by fractional distillation. This is rich in olefins and forms an excellent base material for the manufacture of detergents.

The asphalt works consists of blowing plants for the manufacture of fully-blown and semi-blown asphalts, units for the manufacture of cut-back asphalts, and asphalt emulsions. There is also a large filling plant for packing the various asphalt products.

For the manufacture of gasoline from residual base materials, there is a thermal cracking unit working according to the Dubbs process. Part of this plant is equipped for the selective cracking of paraffin-base materials into gas, gasoline, and fuel oil, and in another part, asphalt-base materials are processed into gas, gasoline, and petroleum coke.

A catalytic cracking plant working on the "fluid bed" principle, which took nearly two years to build, will shortly be in full operation. The magnitude of this project may be gaged from the following figures: The total number of engineering (1135) and manufacturer's drawings (2050) made was 3185; the weight of the reactor and regenerator (including all accessories and equipment) is 2326 tons, to which should be added the catalyst charge of 625 tons; the length of the piping installed amounts to 34 miles, of which 24 miles are of steel pipes and 10 miles copper pipes; the total amount of installed power is 17,500 hp., the total amount of cooling water per hour is 700,000 Imperial gallons; the number of piles driven 880 and quantity of concrete used 2000 cu metres.

The Pernis cat cracker, with an annual capacity of 1,250,000 tons, is a vital link in the chain of processes designed to secure the maximum possible yield of high-grade products from crude oil. It converts a heavier diesel type of oil into high-grade petrol and, together with other units, contributes to the achievement of as high a degree of flexibility as possible in refinery operations. The cat cracker is fed from a feed preparator, in which long residue is processed into distillates and short residue. Valuable gases obtained as a byproduct of the cracking process are to be supplied to the nearby municipalities of Rotterdam and the Hague to supplement the supply of town's gas for domestic use. A pipe line is being built from Pernis to Rotterdam to this end.

The refinery also has a thermal reformer, in which gasoline with a low octane rating is converted into a higher quality gasoline. For further processing of the cracked gas, obtained during the various cracking processes, a number of plants have been installed in which the gases are purified and split up into valuable components, such as butane and propane. Hydrogen sulfide from these purification plants is converted into sulfur in a Claus Kiln installation.

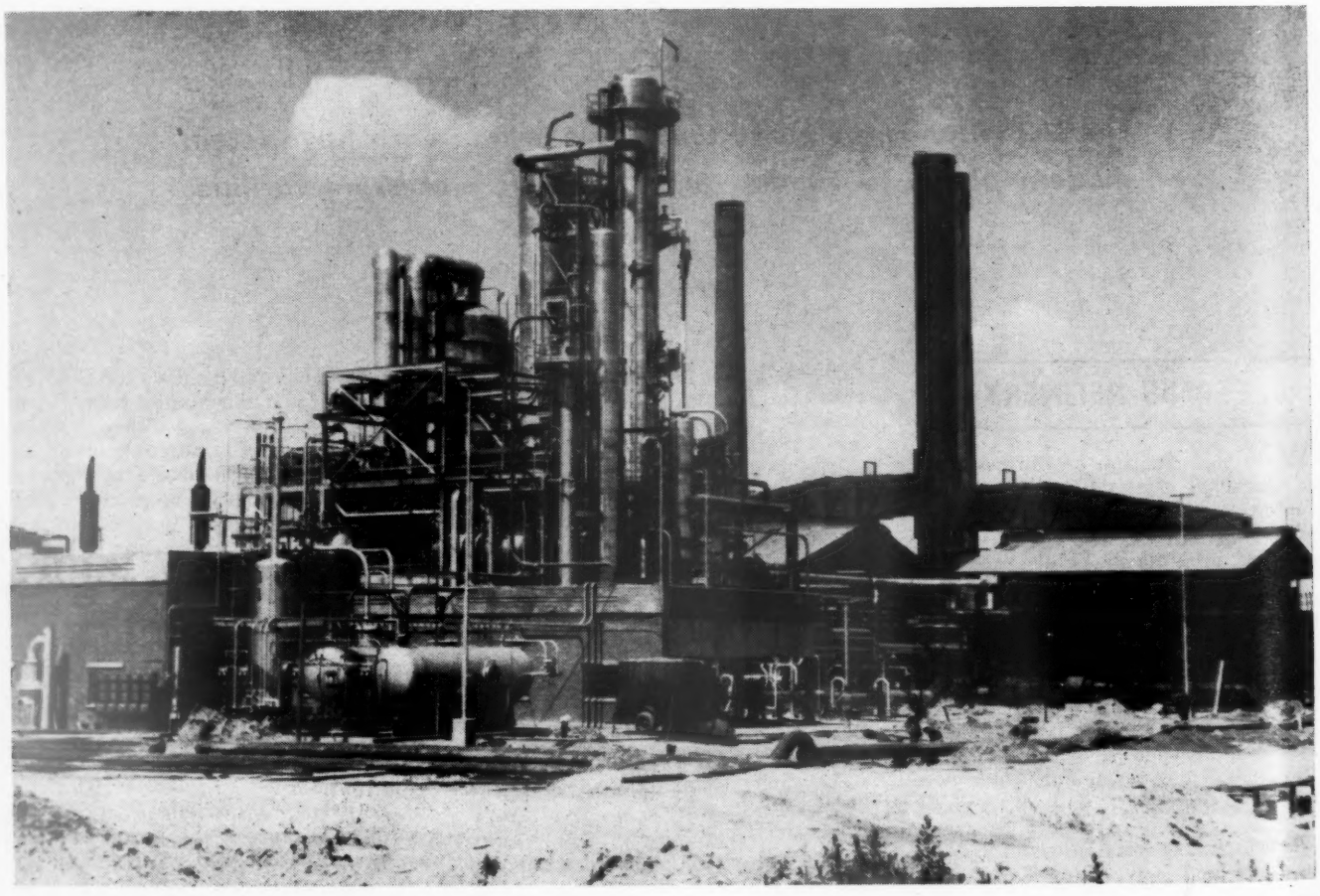
For the purification of thermally cracked gasoline there is an acid refining and redistillation plant. All gasolines are treated to improve their odor in two "Doctor" treaters. To meet the demand for special gasolines for industry a gasoline redistillation unit is in use. An acid refining plant for kerosine makes it possible to manufacture purified lamp kerosine. In a tetra ethyl lead (TEL) mixing unit the finished motor gasoline is blended with requisite quantity of TEL.

ANTWERP REFINERY

Soon after the second world war the Anglo-Iranian Oil Company examined, in connection with the extension of their refinery capacity for Middle East crude oil, the advantages to be had by the construction of new refineries in North-West Europe. It soon became apparent that a plant in the Low Countries would be well placed to supply the combined needs of an important group of markets covering the Benelux countries and parts of Switzerland and the Rhineland. On closer scrutiny it was found that the envisaged AIOC outlets in the above markets would not, for some time, be sufficient to justify the construction of a range of products economically. As the AIOC had already established commercial relations with the Belgian group known as Petrofina, however, it was clear that the combined outlets of the two groups would justify such a venture.

Also, the Belgian Government, which all along had been anxious to see a

First major refinery at Antwerp, Belgium, owned by Anglo-Iranian and Petrofina.



modern refinery erected in their country to manufacture a full complement of finished petroleum products, readily supported the project. In consequence, in the spring of 1948 AIOC and Petrofina decided to go forward with plans to construct a joint refinery at Antwerp with an intake capacity of 1,320,000 metric tons of crude oil per annum. An operating company, Societe Industrielle Belge des Petroles, was formed, and a nucleus of staff set up.

The major requirements for the construction of the refinery were a suitable site adjoining a deep water port, good water and rail communications to the markets in the hinterland, and availability of labor, material and foreign currency to enable the work to proceed rapidly. The first task was to choose the best site in the neighborhood of Antwerp. Eventually a site was selected enclosed by a bend of the river approximately five miles below the city, at the point where the dock system communicated with the river. An area of nearly 375 acres was acquired, of which 100 acres consisted of consolidated fill laid down when the Antwerp dock system was extended 26 years ago, the remainder being at "polder" level, i.e. about 14 ft below high tide level of the river.

It was known that the Antwerp municipal authorities entertained a long term policy for transferring the oil importing and storage installations from their present site at Kiel upstream of the town to an area further down the river, so as to avoid the dangers of tankers and other petroleum product-carrying craft moving in a narrow channel virtually throughout the entire length of the city. Parallel with the Belgian Government's interest in creating a domestic refining industry, the Antwerp City Fathers saw an opportunity of putting this project into effect, and agreed to erect an oil dock alongside the refinery site capable of accommodating the largest sea-going tankers.

Plans were formulated whereby the bulk of the material excavated from this new petroleum dock would be spread over the polder zone of the refinery site to bring the entire area up to a level approximately equal to that of the high tide in the river, thus providing a flat, level site for the construction of the refinery. The building of this mammoth dock, measuring 2000 ft by 650 ft with a turning basin 1300 ft square, and with an overall depth of 400 ft, was in itself an immense undertaking, involving excavation of nearly 3,000,000 cu yd of soil.

While negotiations with the local authorities were in progress, a study of the process and utility plant was undertaken and inquiries issued to specialists British and American contractors for their supply and erection. These preliminary studies were completed early in 1948, and contracts placed in September of the same year with a U. S. company for the process units, and with British firms for a complete power and steam generating station. On account of the prevailing freer conditions of currency exchanges in Belgium it was found possible to exercise a large measure of choice in the source of supply as between Belgium, Britain, and the U.S.A., for what were normally long-term delivery items, although an essential feature of the procurement was to obtain the maximum amount of material locally.

The peculiar character of the polder site, where the upper layers consist of some 15 ft of highly compressible peat, posed unusual foundation problems. An exhaustive investigation was carried out with the aid of the Belgian Geographical Institute and other experts, and the layout of the refinery was conditioned, to a large extent, by their findings. For process plant and other concentrated loads pre-cast reinforced concrete piles, driven into good bearing sand 50 ft below the surface, were adopted; but some apprehension was felt, on account of the peat, as to the behaviour of storage tanks. It was eventually decided to carry out a full-scale test of conditions by erecting a standard 144-ft crude oil tank and observing settlement under a full load of water. The results proved satisfactory.

An interesting feature of the Antwerp refinery concerns the cooling water, which is being pumped from the oildock and discharged, after passing through the units, via safety holding basin, directly to the river. This water is practically fresh, with only fortuitous contamination of salt water, whenever the lock gates of the harbor and canal system are operated at high tide.

Preliminary work began on the site towards the end of 1949, and the refinery was completed and came on stream within the set target date, i.e. autumn 1951. The nominal capacity of the Antwerp refinery is 1,320,000 metric tons of crude oil a year. The main items of process plant are: Crude distillation unit, visbreaker and thermal cracking unit, reformer, redistillation unit, cracked PD acid treating plant, kerosine acid batch washer and copper chloride treaters. The power plant consists of two 4250 KW turbogenerators and four 75,000 lb per hr 600 psi boilers. Premium and regular grade motor spirits, kerosine, gas oil, and a variety of fuel oils are being manufactured. Distribution of products from the refinery is carried out 80 per cent by barge over the Benelux area canal system, 10 per cent by rail tank car, and the balance by road.

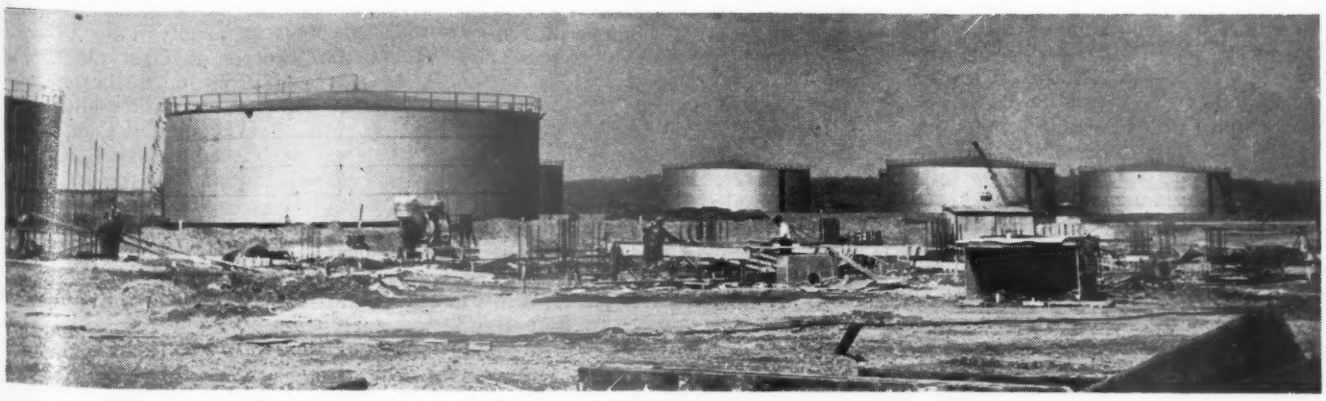
CORYTON REFINERY

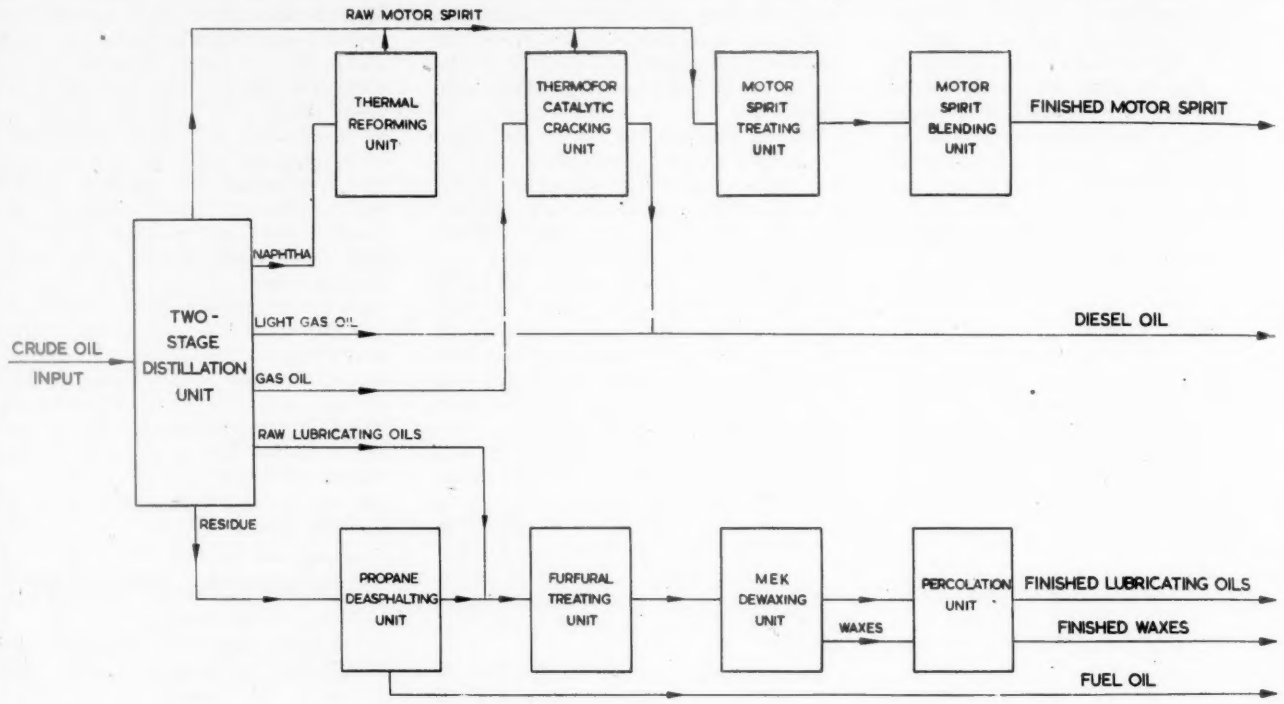
On August 31, 1950, with the British Powell Duffryn group as joint partners, Socony-Vacuum launched a program of expansion, the main feature of which is the construction of a new refinery at Coryton on the Essex bank of the Thames 25 miles east of London. Although primarily designed for the production of high grade lube oils, the new undertaking will also provide the full range of petroleum products.

The Coryton project, scheduled for completion on January 1, 1953, represents a substantial British - American capital outlay exceeding £10,000,000 ($28,000,000).

Total expenditures on the Coryton refinery itself and other extensions of the company's activities cannot yet be estimated closely. Arrangements have been completed for a substantial loan from the Finance Corporation for Industry, and it is anticipated that further shares will be issued for cash to Socony-Vacuum Oil and Powell Duffryn Group. During the past financial year Vacuum Oil Company's capital was increased first to £10,000,000 ($28,000,000), and later to £12,500,000 ($35,000,000). The refinery will process approximately 850,000 tons of crude oil per year (16,000 bbl 1 day) and, by manufactur-

Storage tanks at Coryton refinery on Essex bank of the Thames east of London.





Vacuum Oil Company, Ltd., Coryton refinery process scheme.

ing several products that are now largely imported, will effect a handsome saving in dollars to the United Kingdom. It will be one of the few in the world designed mainly for the manufacture of lubricating stock oils. The Coryton plant will also produce a high grade motor spirit to be marketed under the brand-name MOBILGAS, as also diesel oils, fuel oil, and petroleum waxes.

The processing units will incorporate all that is most modern in oil refinery practice. An integral part of the plant will be a Thermofor catalytic cracking unit to enhance the quality and augment the quantity of motor fuel produced. This unit will be the first cat cracker of its type to be built in Britain, and the second in Europe. Its operation requires hot catalyst circulating within the unit at a rate of 300 tons per hour. The structure will have a height of 250 ft.

Forming part of the project is a complete power station to supply the necessary steam and electric power to the refinery. The boilers have capacity to raise 200 tons of steam per hour, and the electricity generated will suffice to meet the needs of a town of 100,000 inhabitants.

Vacuum Oil Company, Ltd., has placed the main contract for the construction of the refinery with the Lummus Company, Ltd., and Foster Wheeler Company, Ltd. They are working in close collaboration with a number of oil refining engineers loaned to Vacuum Oil by the Socony-Vacuum Oil Company, Inc. At least 95 per cent of the equipment and material is being supplied by U. K. manufacturers.

Rapid progress has already been made on the site. An immense amount of preparatory work is found necessary as the site is low-lying, partly waterlogged and incapable of supporting any but small loads. At high tide the ground level is 8 ft below that of the Thames. This work has entailed placing over half a million tons of gravel for site levelling, driving over 10,000 piles 50 ft long and pouring 40,000 tons of concrete for foundations. There will be 500 miles of piping in the completed refinery. The construction force now exceeds 1000 and will gradually go up to a peak of about 3500 in mid-1952. At present this force is employed mainly on foundations, tank erection, and on fabrication of equipment for the process units.

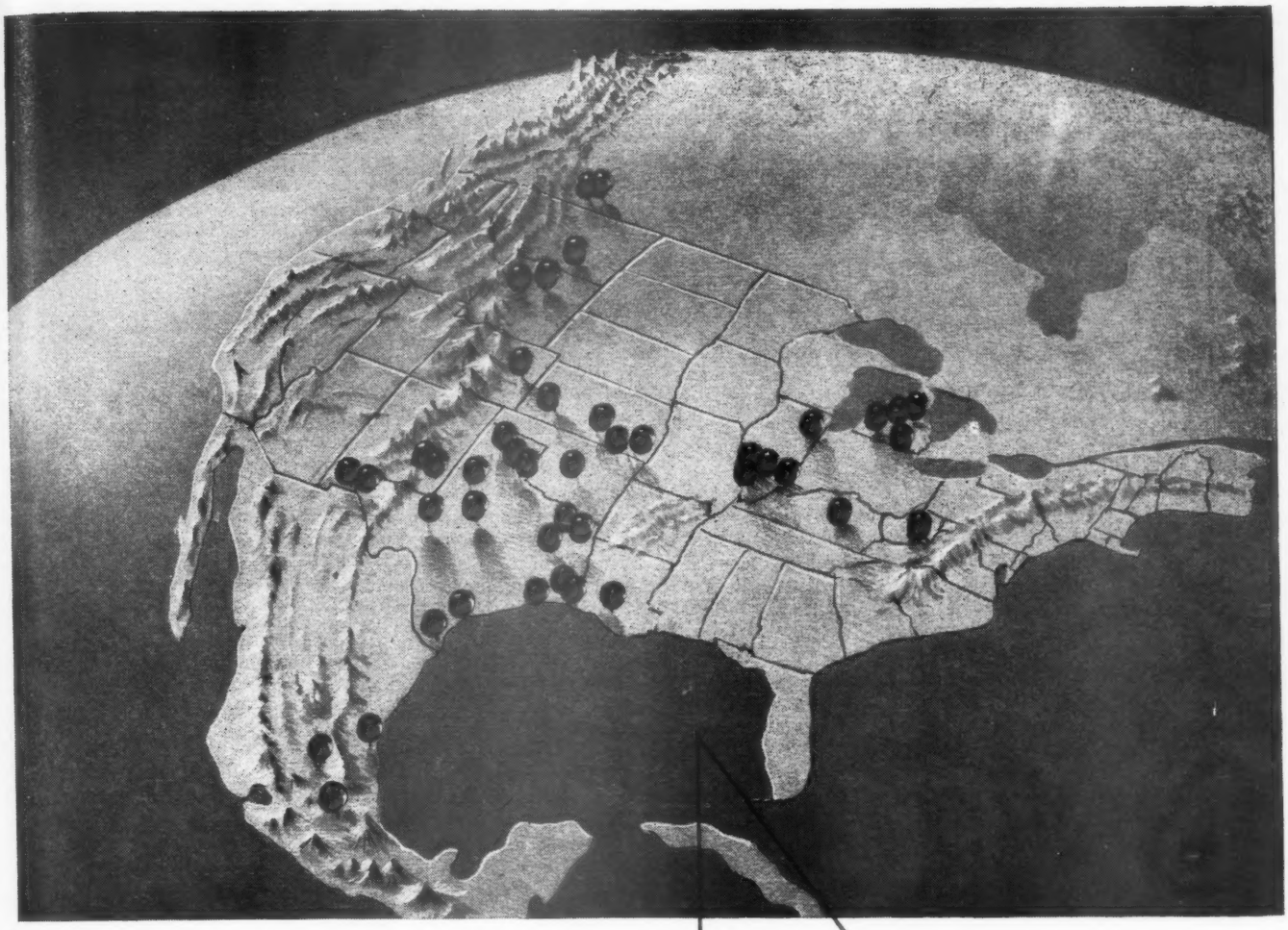
The technique first used in wartime in the construction of Mulberry Harbor will be employed to install a new jetty for withdrawing cooling water from the Thames River. A concrete caisson will be built in dry dock, floated into the correct position alongside the refinery and sunk to form the jetty head on which will be mounted the pumps supplying 45,000,000 gal of river water per day to the refinery for cooling purposes.

The existing jetty and storage facilities are to be modernized to enable super-tankers, carrying about 32,000 tons of crude oil, to discharge at the rate of 2000 tons of oil an hour. The jetty will also be used for the outward shipment of refined products, including the transport of lubricating stock oils to the company's works at Birkenhead. These oils will be carried in a coastal tanker that is under construction by the Grangemouth Dock and Shipbuilding Company, Ltd.

The Coryton project also provides for the building of a mechanical workshop, warehouse, office building, laboratory, loading racks, garage, and canteen. Over 700 men and women will be employed permanently. The company's existing house property is being enlarged by the immediate construction of houses for key personnel. The firm owns nearly 1400 acres of land in the area.

It is worth recalling that since 1866 the original Vacuum Oil Company (later Socony-Vacuum Oil Company, Inc., of New York) has played a noteworthy part in the evolution of the petroleum industry, especially in the development of high-grade oils and greases for the lubrication of all types of engine and machinery. It has also pioneered several of the well-known methods of petroleum refining, including the "vacuum" distillation process from which it derives its name, and the solvent refining process. More recently it has done a great deal of research on the production of high octane fuels by means of the catalytic cracking process, and on the use of chemical additives for further improving the performance of lube oils.

In 1885 the Vacuum Oil Company of America established the first U. K. office in Liverpool, and in 1893 the head office was moved to London. Fifty years ago it was incorporated as a Limited company under the U. K. laws to take over the business previously conducted by the American concern. Vacuum owns oil compounding and blending and grease manufacturing plants at Llandsworth and Birkenhead. * * *



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Some Corrosion Problems in Petroleum Refineries†

JOHN F. MASON, JR.*

CORROSION of equipment in petroleum refineries has for many years represented a major portion of operating costs and oftentimes this condition has been aggravated by the misapplication of available metals and alloys. Over the past 25 years the corrosion engineering section of the International Nickel Company has been active in investigating corrosion problems in the petroleum industry and considerable quantitative information has been obtained on the behavior of different materials of construction under varying conditions of service. It is the purpose of this paper, therefore, to present an analysis of 15 actual problems concerning corrosion of refinery equipment that were submitted for our consideration. The solutions to the problems are based on the accumulated practical experience of the staff of the corrosion engineering section as well as on such quantitative test data as we have developed in refinery services through the use of our spool-type specimen holders.

The assembly consisted of previously cleaned and weighed specimens of the several metals and alloys to be tested, mounted on the spool-type holder with non-metallic parts of Bakelite or porcelain to separate and insulate the specimens from each other and from the metallic parts of the holder. Two similar specimens of each material were included on each spool. The completed test assemblies were fastened firmly in place in the desired test locations in operating plant equipment and allowed to remain for sufficient lengths of time to give reliable indications of corrosion behavior. Each of the test specimens used had an exposed area of 0.5 square decimeter.

Upon completion of tests, the spools were removed, dismantled, and the specimens examined, cleaned of all scale and corrosion product, and reweighed. From the weight losses, areas of specimens and duration of exposure, the corrosion rates were calculated in terms of milligrams per square decimeter per day (mdd), and these rates transposed to inch penetration per year (ipy), the unit used in the accompanying tables. This unit is based upon the assumption of uniform corrosion in practice from one side of the metal only. The rate shown for each material is the average of the two specimens included in each test. In addition, each specimen was examined for cracking, pitting, and other forms of local attack. Where pitting or local attack occurred, depth of the 5 or 10 deepest pits was measured microscopically or with a depth gauge. This method of test was substantially in accord with ASTM Recommended Practice for Conducting Plant Corrosion Tests, A224-41.[1]

The problems submitted for analysis are as follows:

Problem 1

Materials Used: Steel tubes with an 0.095 in. wall in a heat exchanger used in combined straight run and cracking distillation service gave a life of only 9 months when failure occurred due to pitting and general corrosion, particularly where the tubes passed through the steel baffle plates. Muntz Metal tubes were used as replacement and the life was increased from 3 to 5 months.

Service Conditions: Tube interior: Gas oil having 0.6 to 0.8 per cent organic sulfur compounds. Tube exterior: Depropanized naphtha containing 0.035 to 0.10 per cent organic sulfur including 4-40 mg RSH/100 cc plus trace of H_2S.

Temperature: 350-600 F. (Ave. 450 F.)

Operating pressure: 225 psi inside tubes and 40 psi outside.

Aeration: None.

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Discussion: Depropanized naphtha per se is not considered to be particularly corrosive even at elevated temperatures and, therefore, the problem resolves itself into a consideration of the effect of the organic and inorganic sulfur compounds in promoting corrosion of mild steel and Muntz Metal. No quantitative test data were available under the actual service conditions described but an opportunity was provided to expose some specimens of various metals and alloys on our standard spool-type specimen holders in naphtha contained in the sump of the top tray of a topping unit and in the bottom of a fractionating bubble tower wherein sulfur compounds were present at elevated temperatures and it is believed that these conditions are somewhat analogous to the problem application to indicate the probable suitability of other materials for the service in question. The test conditions and results are given below:

Test 1—Specimens exposed for 538 days in sump of the top tray of a topping unit to naphtha containing 0.008 per cent sulfur plus traces of H_2O to H_2S. The temperature varied between 290 and 360 F with an average of 320 F and the velocity was 6 in. per second.

Test 2—Specimens exposed for 75 days in bottom of fractionating bubble tower handling oil with a sulfur content of 0.751 per cent and a boiling range of 164 F to 600 F at normal pressure. The temperature varied between 675 F and 700 F with an average of 690 F. Aeration was nil and agitation was turbulent.

	Indicated corrosion rate-inch penetration per year		
Material	Test 1	Max. pitting during test-in	Test 2
Monel	0.0003	None	*
Nickel	<0.0001	None	*
Inconel	0.0001	0.003	0.0022
Types 302 & 304 S.S.	0.0001	0.008	0.0003
Type 316 S.S.	<0.0001	0.006	—
Mild steel	0.0031	0.021	0.144
Type 502 S.S.	—	—	0.017
Type 410 S.S.	—	—	0.0015
Red brass	—	—	*
Admiralty metal	—	—	0.0059

* Specimens, originally 0.031 in. thick, were completely destroyed during test period.

The data from Test 1 indicate that while the general corrosion resistance of mild steel is of a satisfactory low order, it has a strong tendency to suffer severe localized attack in the form of pitting. The chromium containing materials such as Inconel and the austenitic stainless steels also showed the same tendency but to a much lesser degree. Monel and nickel were free of this type of attack and in addition showed negligibly low overall corrosion rates based on weight loss at this temperature.

In Test 2 none of the specimens showed any evidence of pitting attack but it will be observed that mild steel was subject to a high rate of corrosion. Monel and nickel cannot be considered for the application because as shown by the data in this test they are susceptible to severe general and intergranular attack by sulfur compounds at temperatures much in excess of 500 F. It was mentioned that Muntz Metal tubes were substituted for mild steel and that an additional 3 to 5 months life was obtained. It was not reported how these tubes failed but if it was caused by dezincification, there is a good possi-

†Presented at the Petroleum Mechanical Engineering Conference, Tulsa, Oklahoma, September 24-26, 1951 of The American Society of Mechanical Engineers.

*International Nickel Company.

[1]A.S.T.M. Standards, Part I, p. 522, 1944.

bility that inhibited Admiralty Metal will give greatly superior performance as its general corrosion rate in Test 2 was only 0.0059 in. per year. Another material worthwhile considering is Type 502 stainless steel, which showed a superiority over mild steel of about 10 to 1. By increasing the chromium content to 13 per cent (Type 410 stainless), the ratio is extended to approximately 100 to 1. The latter materials would probably be more economical investment.

The accelerated corrosion that occurred on the steel tubes where they passed through the baffle plates was in all probability caused by concentration cell corrosion of the metal—ion type. In practice, these cells are usually set up by differences in the rate of movement of the corroding solution, or, more effectively, by movement of one part of the solution while another part remains practically stationary. In this way, the stagnant portion in the crevice between the tubes and baffle plates become saturated with products of corrosion, or metallic ions, while the moving portion sweeps them away leaving the solution low in concentration of corrosion products. This condition sets up a flow of electric current, which causes galvanic or accelerated corrosion of the metal in the region where a relatively low ion concentration is maintained, that is at the edge of the juncture of the tubes and baffle plates.

Problem 2

Material Used: Steel tubes with an 0.095 in. wall in a heat exchanger used in combined distillation and cracking service gave a life of 12 months when pitting occurred on the outside surface and accelerated corrosion where the tubes passed through the steel baffle plates.

Service Conditions: Tube interior: Crude petroleum with 0.3 to 0.5 per cent organic sulfur.

Tube exterior: Gas oil having 0.6 to 0.8 per cent organic sulfur compounds.

Temp.: –10 to 650 F. (Ave. 450 F.)

Operating Pressure: 225 psi inside tubes and 300 psi outside.

Aeration: None.

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Discussion: This case of pitting and corrosion of the outside of the tubes by gas oil containing organic sulfur compounds is similar to Problem 1 and the same comments would seem to apply. In other words, there is every indication that Types 410 and 502 stainless steel as well as inhibited Admiralty Metal will provide much better performance in the service in question than mild steel.

Problem 3

Material Used: Steel tubes with an 0.095 in. wall in a heat exchanger used in conjunction with a sulfuric acid alkylation unit gave a life of 3 to 4 months when failure occurred at junction of tubes and steel tube sheet on acid side.

Service Conditions: Tube interior: Steam at 140 psi.

Tube exterior: black alkylation spent acid 89.91 per cent H_2SO_4, 98 per cent fresh acid added to bring concentration to 92 per cent.

Temperature: 330 F Max., 200 F Ave.

Operating Pressure: 140 psi inside tubes and 65 psi outside.

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Discussion: The point of failure is typical of concentration cell corrosion of the metal ion type as discussed in Problem 1. High concentrations of sulfuric acid over about 80 per cent and low moderate temperatures are favorable for the satisfactory performance of mild steel except where conditions of high velocity or turbulence are encountered. The effect of the latter forces is to remove the protective ferrous sulfate coating that forms. It generally is not practical, however, to use mild steel with concentrated sulfuric acid solutions at elevated temperatures up to 300 F even under quiet or stagnant conditions because of excessive corrosion attack. Usually its application is confined to temperatures under about 120 F.

Type 316 stainless steel and Carpenter 20 while also resistant to concentrated sulfuric acid solutions, even under velocity conditions cannot be used safely at temperatures in excess of about 180 F. Under the circumstances, it seems apparent that the only material that might be considered worthwhile for the application in question is Hastelloy B, which is reported to have fair resistance to corrosion by concentrated solutions of sulfuric acid at temperatures up to 300 F. The silicon irons, such as Duriron and Durichlor, as well as Hastelloy D would also demonstrate adequate resistance to attack but these materials are available only in cast form and would not readily lend themselves to use as heat exchanger tubing.

Another possibility is the use of Karbate tubing but this material is somewhat brittle and care must be exercised in the handling of it. Apparently as the corrosive conditions are so severe and the availability of materials in wrought form is rather limited for tubular elements in a heat exchanger, it might be considered practical to redesign the unit along the lines of the standard sulfuric acid concentrators in refineries where the evaporator bodies usually are of steel, lined with lead and this covered with acid resistant brick. The heater tubes or thimbles commonly are of Hastelloy D and other parts of Duriron, Corrosiron, and carbon are used.

Problem 4

Material Used: Carbon steel lye regeneration tower with cast iron trays and bubble caps. The steel distributor pipe on the unregenerated lye inlet was completely corroded away and was replaced with a splash plate 4 ft from the nozzle or 1 ft from the opposite side of the tower. A hole 1/16 in. in diameter developed in the tower shell directly opposite the inlet nozzle. This hole was in the upper part of a badly corroded area 6.5 in. by 10 in. with lesser corrosion over a large area. The splash plate had been corroded through over an area 8 in. in diameter. This tower has been in service over 2 years.

Service Conditions: Regeneration of lye or caustic soda of 20 Be (15 per cent) containing mercaptans and hydrogen sulfide.

Temperature: At bottom of tower 270 F. At top of tower 240 F.

Operating Pressure: 20 psi.

Aeration: Moderate.

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Discussion: Carbon steel as well as cast iron is generally subject to severe corrosive attack in contact with caustic soda solutions at elevated temperatures. The presence of velocity or turbulence in such equipment tends to accelerate corrosion. It seems evident that the latter effects caused premature failure of the distributor pipe and impingement attack shortened the life of the area in the tower shell opposite the inlet nozzle as well as the splash plate.

Given below are the results of some plant corrosion tests:

Plant corrosion tests in caustic regeneration units.

Test A—In reboiler of caustic soda regenerator unit. Solution entering contained 1-2 per cent sodium hydroxide. 3 per cent sodium phenolate and 0.07 mg per 100 cc of solution as sodium mercaptides. Test specimens were located directly above Monel heating tubes. Temp.: 225 F. Duration of test 131 days.

Test B—In vapor section of caustic soda regeneration unit. Solution entering contained 13.2 per cent sodium hydroxide, 0.37 per cent sulfide sulfur and 0.80 per cent mercaptide sulfur. The average temperature was 300 F. The duration of test was 55 days.

Test C—In reboiler of caustic potash regenerator unit. Solution entering contained 25.5 per cent potassium hydroxide, 37.8 per cent potassium isobutyrate, 5.5 per cent potassium sulfide, 1.9 per cent potassium mercaptides, and 2.1 per cent potassium carbonate. Test specimens were placed in boiling liquor at upstream side of overflow weir. Average temp. 286 F. Duration of test 140 days.

Test D—Same as "C" except test specimens were exposed in vapor at downstream side of overflow weir. Average temperature 286 F. Duration of test 140 days.

Material	Corrosion rate, inch per year			
	Test A	Test B	Test C	Test D
Monel	.001	.002	.003	.002
Nickel	.024	.002	.022	.016
Inconel	.0001	.0003	.001	.002
Mild steel	.020	.033	*	.012
Ni-Resist (Type 1)	.023	.013	.046	.019
Cast iron	.017	—	.040	.014

* Specimens completely destroyed during test, original thickness of specimens 0.062 in.

It will be noted that in one test mild steel specimens, originally 0.062 in.

thick, were completely destroyed in 140 days while in the other three tests the corrosion rates of the material were of a relatively high order. Monel and Inconel gave outstanding performance and as a matter of fact Monel is being rather widely used in the petroleum industry for caustic soda regenerator reboilers and tubes, for lining the bottom sections of regenerator towers and for pumps, piping and preheaters handling the hot solutions. Inconel has also proved to be a useful material for evaporator tubes or other parts of regenerator systems and should be used rather than Monel in this service where metal temperatures in excess of 500 F are encountered as Monel is subject to sulfur embrittlement at higher temperatures.

In view of the difficulties described with mild steel and the proved outstanding performance of Monel under such conditions, it was suggested that the affected parts of the tower be replaced or lined with Monel.

Problem 5

Material Used: Carbon steel piping, 10 in. in diameter by ½-in. wall in a crude flash tower handling Quiriquire crude suffered a loss of 3/32 in. in a year accompanied by severe pitting and a gouging effect.

Service Conditions: The crude is charged to the flash tower at a rate of 25,000 W. G. per hour and at a viscosity of 400 seconds at 100 F Saybolt. The crude is reported to contain organic acids (naphthenic acids), chlorides, and sulfides.

Temperature: 580-630 F. (Ave. 600 F).

Operating Pressure: 15 psi.

Aeration: None.

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Discussion: Naphthenic base crudes such as Quiriquire and Monaca, have proved to be highly corrosive at elevated temperatures. Some plant corrosion tests have been made in the processing of these crudes and the following data have been obtained.

Test 1—Specimens exposed for 17.5 days in a 2nd stage separator of a combination unit handling cracked petroleum gas oil from Monaca crude containing combined sulfur up to 1.27 per cent as H_2S, mercaptans and organic sulfides. The temperature was 750-780 F with an average of 760 F and the flow varied between 17,000 to 21,500 W. G. per hour through a 6-in. ips line.

Test 2—Specimens exposed for 196 days in a first stage intercondenser of a combination unit handling cracked petroleum reduced crude containing up to 1.1 per cent sulfur as H_2S, mercaptans, plus organic sulfides. For 131 days Monaca crude was being processed during the test and for 65 days Quiriquire crude. The temperature was 790-820 F with an average of 800 F and the flow varied between 16,000 to 18,000 W. G. per hour through a 12-in. extra heavy pipe.

Material	Indicated corrosion rate-inch penetration per year	
	Test 1	Test 2
Monel	0.238	*
Nickel	0.232	*
Inconel	0.0074	0.0092
Type 302 S.S.	0.0042	0.0023
Type 316 S.S.	0.0037	0.0022
Type 430 S.S.	0.0060	0.0003
Type 502 S.S.	0.030	0.0071
Cast iron	0.043	0.054
Mild steel	0.095	0.027

* Specimens originally 0.031 in. thick were completely destroyed during test period.

The temperature conditions of the tests are somewhat higher than in the problem application but the data might serve to indicate the relative behavior of the various materials investigated. It will be observed that in Test 1 mild steel showed a corrosion rate of 0.095 in. per year, which is almost identical with the 3/32-in. loss per year reported for the 10-in. piping in the service in question. Apparently, some improvement of the order of 3 to 1 would be provided by the substitution of Type 502 stainless steel and, of course, the higher chromium content alloy, Type 430, as well as the austenitic stainless steels and Inconel would give superior performance. It should be noted the powerful effect sulfur compounds at elevated temperatures, above 500 F have on Monel and nickel in causing accelerated corrosion.

Problem 6

Material Used: 10 lb lead on walls and 14 lb lead on cones of steel shell light fuel oil agitators. The lead lining on the walls is replaced every 5-6 years and the lining on the cone shaped bottoms every 3-5 years. The agitator roofs are replaced approximately every 3 years. Considerable patching is required during the life of the linings and corrosion of the underlying steel shell occurs through holidays in the linings.

Service Conditions: Treating light fuel oils with one of the following: 93-98 per cent H_2SO_4, 2-10 per cent sodium hydroxide and 19-25 per cent sodium plumbite solution. In addition the oils contain mercaptan sulfur, elemental sulfur, and polysulfides. During acid treating the batch is agitated with air for 15 min, and during lye treating the batch is agitated with air for 6 to 12 hours. It was also reported that the batches contained small quantities of elemental sulfur and lead sulfides as suspended solids and that a maximum copper pickup from the equipment of 0.5 ppm copper can only be tolerated. The temperature of the acid batch varies between 65 and 95 F with an average of 75 F and of the lye batch between 120 and 130 F with an average of 125 F.

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Discussion: In these batch operations the same vessel was used for acid washing, neutralization and "doctoring" for removal of traces of mercaptans. A plant corrosion test was made in a batch vessel in which the acid treatment, water washing and caustic treatment were all carried out in the same unit and agitation was done with air. Given below are the test conditions and the results obtained together with some data from a sodium plumbite solution:

Test 1—Specimens immersed 3 ft above bottom of cone in fuel oil treating tank during treatment with 4 lb per barrel of 66 Be sulfuric acid followed by water washing and treatment with 10 Be Caustic soda. Agitated with air. Temperature 80-105 F. Duration of test 56 days.

Test 2—Specimens installed in an agitator and immersed in sour gasoline, mixed with a sodium plumbite solution for the removal of mercaptans and H_2S. Moderate aerations and high agitation. Temperature 60-80 F. (Ave. 70 F.) Test duration 150 hr actual operation; spool was installed for 125 days.

Material	Indicated corrosion rate-inch penetration per year		
	Test 1	Test 2	
		Based on 150 hours	Based on 125 days
Monel	0.018	0.0002	<0.0001
Nickel	0.037	0.0002	<0.0001
Inconel	0.016	0.0001	<0.0001
Worthite	0.012	—	—
Hastelloy A	0.003	—	—
Chemical lead	0.038	0.073	0.0037
Type 1 Ni-Resist	0.036	0.0008	<0.0001
Cast iron	0.056	0.012	0.0006
Mild steel	0.021	0.010	0.0005

The data from Test 1 indicate that Hastelloy A was the best of the materials tested, followed by Worthite, Inconel, and Monel. It should be mentioned Monel is being widely used in this service particularly where mechanical agitation is employed. Air agitation increases somewhat the corrosion rate of Monel during the acid treating cycle, although it is not excessive because of the relatively short time of contact of only 15 minutes with the media during the cycle. While Inconel showed comparable corrosion resistance with Monel in the test we would prefer to see the latter material used in such service because of its better reliability in contact with dilute solutions of sulfuric acid. In practice, while concentrated sulfuric acid is added to the oil batch, it is readily diluted down by picking up water from the oil and usually must be further diluted with water to accomplish good separation of the acid sludge after treatment, so that water solutions of acid concentration down to 5 or 10 per cent may be encountered in the separation systems. Monel is not resistant to attack by sulfuric acid solutions in excess of about 80 per cent concentration at atmospheric temperature and when 66 Be acid is added to an oil batch care is exercised to avoid any contact of it with the side walls of the Monel vessel until it has had a chance to mix with the oil.

The Hastelloy alloys are rather expensive and in the event this might eliminate them from consideration, the next most logical replacement material for chemical lead is Monel, which based on the test results should give better than twice the life of the present equipment without the necessity of continual patching. The ultimate performance of Monel

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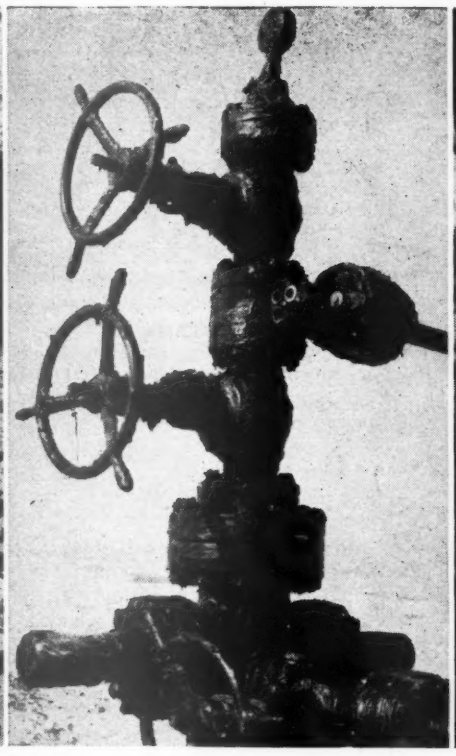

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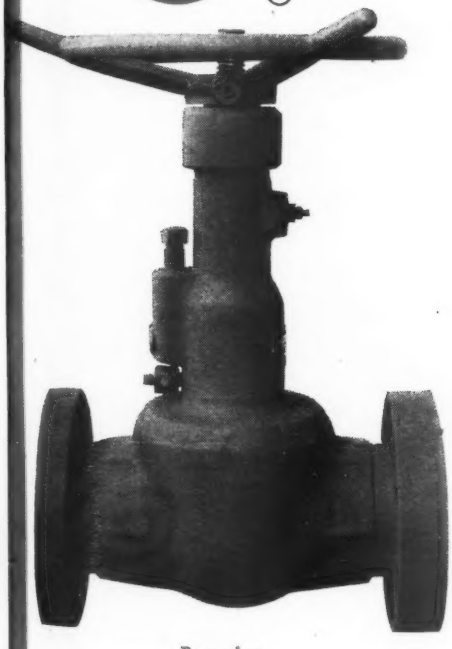

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could be considerably improved by providing mechanical agitation of air agitation during the acid washing cycle, thereby also reducing the amount of copper pickup to a minimum.

In referring to Test 2 wherein the corrosive was sour gasoline mixed with a sodium plumbite solution it will be noted that lead was the poorest of the materials tested and it is this metal of which the equipment was constructed. Here again, the indications are that Monel would probably represent the most practical and economical material to use in this particular service. For cast equipment such as pump bodies and valves, Ni-Resist would seem to be an excellent choice as it showed up to be more than 10 times better than cast iron as well as mild steel.

Problem 7

Materials Used: 12-in. extra heavy carbon steel pipe with ½-in. wall used as a tube and tank cracking coil failed in 1½ to 2 years due to general corrosion by vapors in bends leading from the top of the separator to the high pressure exchangers.

Service Conditions: Pipe handles reduced crude vapor containing mercaptans, H_2S, free sulfur, SO_2 and chlorides.

Temperature: 730-740 F. Ave. 735 F.

Operating Pressure: 70 psi.

Aeration: None.

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Discussion: The change in flow of the vapors in the pipe at bends evidently sets up a more or less turbulent condition at these locations which causes accelerated corrosion of steel through the mechanism of removing or preventing the formation of protective corrosion product films. No data were available to illustrate the effect of velocity on steel in the service in question but the following plant test data were obtained under turbulent conditions and they will give some idea as to what materials might be used to better advantage by providing additional corrosion resistant insurance.

Test 1—Specimens exposed in cracking coil fractionator for 197 days to reduce crude oil having an average sulfur content of 0.21 per cent and an average API gravity of 29.

Temperature: 700-720 F, Ave. 715 F.

Aeration: None.

Agitation: Turbulent.

Test 2—Specimens exposed in cracking coil fractionator for 122 days to reduce crude oil vapors having an average sulfur content of 0.6 per cent.

Temperature: 575-600 F, Ave. 590 F.

Aeration: None.

Agitation: Turbulent.

The data indicate that under some conditions mild steel can suffer exceedingly high rates of attack and if you will refer to Test 1 you will note that specimens of this material, originally 0.062 in. thick, were completely destroyed during the exposure period of 197 days. Under the same conditions Type 502 stainless steel gave very satisfactory performance and would seem to be the most practical and economical material to use to replace the present steel piping. There does not appear to be any necessity in going to the more highly alloyed and more expensive materials for the service in question.

Material	Indicated corrosion rate-inch penetration per year	
	Test 1	Test 2
Monel	*	*
Nickel	*	*
Inconel	0.0008	0.0015
Type 302 S.S.	0.0001	0.0004
Type 410 S.S.	0.0006	0.0015
Type 502 S.S.	0.0033	0.0051
Hastelloy A	0.0002	0.0004
Mild steel	‡	0.018
Type 1 Ni-Resist	0.058	0.025
Cast iron	0.052	0.024

* Specimens originally 0.031 in. thick, were completely destroyed during test period.

‡ Specimens originally 0.062 in. thick, were completely destroyed during test period.

Problem 8

Material Used: Carbon steel propane (cracked distillate) accumulator with an acid-proof cement lining (Vitric No. 10). It is reported that general corrosion and severe pitting occur with a loss of about 1/64 in. per year.

Service Conditions: Two phases in accumulator:

Liquid Phase—Small percentages of sulfides and chlorides having an acidity of 1.0 mg. of KOH per gram with an average $_pH$ of the water settlement 4.4.

Gas Phase—Petroleum gas containing methane, ethane, propane, butane and a small percentage of H_2S.

Temperature: 75-90 F, Ave. 80 F.

Operating Pressure: 60 psi.

Aeration: None.

Agitation: 8000 W. G. of distillate charge per hour.

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Discussion: We presumed that corrosion of the steel beneath the coating occurred through porosity or bare spots that were not covered initially. The corrosion was evidently caused by hydrolysis of the chlorides to form small amounts of hydrochloric acid. While no data were available from a propane accumulator some were developed in a rerun gasoline condensate accumulator and in a reflux water separator where the water layers contained some HCl and H_2S. The test conditions and results are given below:

Material	Indicated corrosion rate-inch penetration per year	
	Test 1	Test 2
Monel	0.0015	0.0019
Nickel	0.0023	0.0023
Inconel	0.0004	0.0002[1]
Type 302 S.S.	0.0005	0.0001[2]
70/30 Cu-Ni	0.011	—
Mild steel	0.056	0.018
Type 410 S.S.	—	0.0009[3]
Type 502 S.S.	—	0.0061[4]

[1] Pitted to a maximum depth of 0.003 in. during test period.

[2] Pitted to a maximum depth of 0.015 in. during test period.

[3] Pitted to a maximum depth of 0.010 in. during test period.

[4] Pitted to a maximum depth of 0.018 in. during test period.

Test 1—Specimens exposed for 59 days in a rerun gasoline condensate accumulator where the water layer contained some HCl and H_2S. The $_pH$ of the water varied from 2.1 to 6.5 and the temperature 70-95 F with an average of 88 F. There was no aeration but the velocity was 0.67 ft per second.

Test 2—Specimens exposed for 414 days in a reflux water separator where the water layer contained some HCl and some H_2S. The average temperature was 120 F.

The rate of corrosion exhibited by mild steel in Test 1 is much higher than the rate reported of about 0.015 in. per year which, incidentally, does not appear to be intolerable. The results from Test 2 appear to be more in line with the problem conditions and it should be pointed out that if something better than mild steel is required for the 10 ft by 30 ft accumulator in question that Monel or nickel in the form of lining or clad on steel be used. While the chromium containing materials including Inconel and Types 302, 410, and 502 stainless steel also showed usefully low corrosion rates they were subject to pitting attack and in view of their known tendency in this respect when used in contact with halogen salts or solutions, we would hesitate to suggest their use in the problem application.

Problem 9

Material Used: Carbon steel for tower top, 70-30 for condenser tubes, Monel for condensate drum lining, carbon steel for transfer lines and for run down tank. It is reported that general corrosion and pitting of some of the materials is occurring but life seems to be indefinite.

Service Conditions: Mixture of light naphtha and water bearing H_2S and some HCl with $_pH$ controlled to 6.5 to 7.5 by addition of anhydrous ammonia.

Temperature: 80-110 F, Ave. 95 F.

Operating Pressure: 10 psi.

Aeration: Moderate.

Agitation: Turbulent in lines—quiet in drums.

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Discussion: While some slight general corrosion and pitting are being encountered with the various materials in this service, it does not appear based on plant corrosion tests that their lives will be premature. As an example, tests made in the water settling section at the bottom of a gas separator taking the overhead from a rerun tower handling gasoline and water from crude naphtha from Oficina (50 per cent), Louden (38.3 per cent) and Mid-Continent (11.7 per cent) crude oils show negligible corrosion rates for the materials in question. The test was run for 194 days at a temperature varying between 70-112 F with an average of 98 F and the results that were obtained are given below.

It is evident that mild steel has a reasonably useful corrosion rate while Monel and 70/30 Cu-Ni are highly re-

Material	Indicated corrosion rate-inch penetration per year
Monel	0.0008
Nickel	0.0007
Inconel	0.0001*
70/30 Cu-Ni	0.0031
Types 302 and 304 S.S.	<0.0001
Type 316 S.S.	<0.0001
Type 410 S.S.	0.0005‡
Type 502 S.S.	0.0043
Type I Ni-Resist	0.0020
Mild steel	0.0090
Cast iron	0.0078

* Pitted to a maximum depth of 0.004 in. during test period.

‡ Pitted to a maximum depth of 0.006 in. during test period.

sistant to corrosion. It was indicated in the report of the problem that steel has a life of 10 years while that of Monel and 70/30 is indefinite. The data would seem to bear this out and what little pitting has been observed in practice is probably not of the serious and penetrating type that leads to untimely failure.

Problem 10

Materials Used: Carbon steel, ½-in. thick used for stack on process furnace employed in the fractional distillation of naphtha. In 10 months corrosion had destroyed the metal at one point near the base completely around the stack. Repairs were made to stack by welding 6-in. I beams as stiffeners around the base plus an interior lining over the corroded area. In another 12 months repairs were again made as corrosion had attacked the weld metal on the interior of the stack.

Service Conditions: Flue gas containing a high content of SO_2 and SO_3. Temperature: 60 F at base of stack to 500 F.

Operating Pressure: Atmospheric.
Aeration: Complete.
Agitation: Turbulent.

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Discussion: The temperature at the base of the stack is below the dew point of the gas and as a result some sulfurous acid is formed which is oxidizing in nature and highly corrosive to carbon steel. The results of a corrosion test made under sulfurous acid conditions at atmospheric temperature are:

Material	Indicated corrosion rate-inch penetration per year
Monel	0.006*
Nickel	0.007*
Inconel	0.0025*
Type 302 S.S.	<0.0001‡
Type 304 S.S.	0.0002‡
Type 316 S.S.	<0.0001
Mild steel	0.011

* Specimens, originally 0.031 in. thick, were perforated during test period.

‡ Specimens of these materials were pitted to a maximum depth of 0.012 in. during test period.

Although in this test the corrosion rate of mild steel is not very high, nevertheless, it has been observed to corrode at a more rapid rate under similar circumstances. Type 316 S.S. proved to be the best of the materials tested and from a practical standpoint it has worked out to be one of the most suitable alloys that may be used in contact with dilute sulfurous acid solutions. Almost without exception Monel, Nickel, Inconel, and the straight 18-8 types of stainless steel suffer localized attack in the form of pitting in this type of service.

Problem 11

Material Used: Carbon steel tower, line, and pump used in the fractional distillation of naphtha. General corrosion and pitting of steel occurs particularly at the liquid level in the tower and in pump casings. It is reported that the bottom of the tower was lined with stainless steel about a year ago and the impeller in one pump was replaced with 4-6 per cent chrome steel.

Service Conditions: Hot cracked naphtha containing H_2S with traces of water.

Temperature: 600-625 F.
Operating Pressure: 100 psi.
Aeration: None.
Agitation: Turbulent.

☆ ☆ ☆

Discussion: Here again, the corrosive conditions must be considered to be similar to Problem 1. As mentioned previously cracked naphtha has not proved to be active in promoting corrosion of metal and alloys and, therefore, our concern lies with the effect of sulfur or sulfur compounds at elevated temperatures on materials of construction. It was shown in the tests listed under Problem 1 that mild steel can be subject to high rates of general attack as well as severe pitting in contact with naphtha and/or gas oil containing organic sulfides and traces of water at temperatures between 290 and 690 F. The available data indicate that the use of 18-8 stainless steel was a wide choice for the lining of the bottom section of the tower where maximum corrosion was encountered with mild steel. It is further indicated that the substitution of Type 502 stainless steel for the impeller is a move in the right direction and it would seem practical to consider using this material for the pump casings as well. Of course, if somewhat better service life is desired over the expected performance of the Type 502 alloy, without going all the way to the use of the austenitic stainless steels, Type 410 should be considered since the corrosion test results indicate a definite superiority of about 10 to 1.

Problem 12

Material Used: Carbon steel used for vacuum tower, overhead vapor line, and vacuum condensate transfer line in the fractional distillation of crude oil. Steel suffers general corrosion and pitting. Vitric acid proof cement is used as a lining in the tower but it breaks up exposing the underlying steel to corrosion. The shell from tray 7 to 16 is very close to the limiting thickness and Type 347 stainless steel has been applied as a lining at Trays 10 and 11. About five of the remaining sections will be in need of relining either with vitric acid proof cement or with stainless steel in the very near future.

Service Conditions: Gas oil mixed with water containing H_2S plus some chlorides at a $_pH$ of 2.0 to 5.0.

Temperature: 70-100 F. (Ave. 80 F).
Operating Pressure: Atmospheric.
Aeration: Moderate.
Agitation: Turbulent.

☆ ☆ ☆

Discussion: The acidity of the gas oil-water mixture is in all probability due to hydrolysis of the chlorides that are present with the formation of small amounts of hydrochloric acid. Corrosion by such conditions was discussed under Problem 8 and data were presented to show the effects of this mineral acid on the performance of various metals and alloys in a rerun gasoline condensate accumulator where the $_pH$ of the water layer varied between 2.1 and 6.5 and in a reflux water separator where acid conditions also prevailed.

It was shown in these tests that steel can suffer relatively high rates of attack and that there are other materials available that are better suited for the application, namely Monel and nickel. These materials have proved to be outstanding in their resistance to corrosion by dilute solutions of hydrochloric acid and the best practical example that may be cited of the use of Monel, in particular, in petroleum refineries is for the lining of the top sections of crude oil fractionating towers where temperatures below 500 F are encountered and corrosion by hydrochloric acid conditions must be provided against.

Neither the austenitic stainless steels nor the straight chromium varieties are employed in this service because of their generally known and proved susceptibility toward pitting attack and the test data from the reflux water separator bears this out quantitatively by the pitting measurements that have been made on specimens of these materials after an exposure of 414 days.

Based on the evidence at hand and practical experience, it would seem more logical to consider the use of Monel or nickel instead of Type 347 stainless steel for relining the remaining five sections of the tower and also for overhead vapor lines and vacuum condensate transfer lines.

Problem 13

Material Used: Carbon steel used for debutanizing tower top, overhead lines, fittings, and reflux condensate drum. In 1949 corrosion in the top head of the tower caused a metal loss of 1/32-in. per year and in the shell from 1/64 to 3/64 in. per year. More recently there appears to be a considerable increase of corrosion over that of previous years. The metal loss in the top head of the reflux drum was 1/32-in. per year and in the shell and bottom head 1/64-in. per year. It was also reported that the debutanizer tower overhead and reflux

lines both show a corrosion rate of 1/64-in. per year.

Service Conditions: Light naphtha mixed with water containing H_2S and some HCl at a $_pH$ of 2.0 to 5.0.

Temperature: 250 F at top of tower—70 F in reflux drum.

Operating Pressure: 60 psi.

Aeration: None.

Agitation: Turbulent.

☆ ☆ ☆

Discussion: This problem should be considered along with Problems 8 and 12 wherein corrosion by hydrochloric acid, the most active constituent in the mixture, is the principal cause of the deterioration of the steel equipment. As mentioned previously, it is not generally good practice to use the austenitic stainless steels or the straight chromium types under such conditions because of pitting tendencies and especially at the top of the debutanizer tower where the maximum temperature is 250 F as it would be expected that the localized attack would be seriously increased. Under the circumstances, therefore, it would be suggested that Monel or nickel be considered for the service in question especially since they have proved over the years to be the most suitable and practicable materials to use in somewhat similar or comparable applications.

Problem 14

Materials Used: Steel regenerating tower used in a furfural recovery system.

Service Conditions: Furfural and water at 360 F. Severe corrosion of mild steel above the vapor line at each tray level in less than a year's time rendered the tower useless and required the installation of a lining.

☆ ☆ ☆

Discussion: Under some conditions it has been found that the decomposition products of furfural at elevated temperatures can be highly corrosive to steel and the following data obtained in a furfural extract separation tower tend to verify this experience. Specimens were exposed for 122 days in the downpour between the bubble trays in the tower where the temperature of the furfural averaged 450 F. There was no aeration but some agitation was reported to flow of the extract.

Material	Indicated corrosion rate-inch penetration per year	Max. pitting during test-inch
Monel	<0.0001	None
Nickel	<0.0001	None
Inconel	<0.0001	None
Type 302 S.S.	<0.0001	None
Type 316 S.S.	<0.0001	None
Chemical lead	0.0026	Perf.*
Type 410	0.0014	0.012
Aluminum 2S	0.0002	None
Type 502 S.S.	<0.0001	None
Mild steel	0.0112	Perf.*
Ni-Resist	<0.0001	None
Cast iron	0.0001	None

* Specimens of these materials were originally 0.062 in. thick.

The data indicate that chemical lead, mild steel, and Type 410 stainless steel are apparently unsuitable for use under the particular test conditions because of their tendency to suffer severe localized corrosion. All of the other materials investigated showed an absence of this form of corrosion and at the same time showed negligibly low rates of general attack. Under the circumstances, therefore, it would appear practical to select one of these as a lining material to protect the steel tower in question, which is doomed to premature failure.

The author has had some firsthand experience with a Monel-lined furfural treating tower equipped with Monel internals and a recent checkup on this installation indicates that it is still in satisfactory condition after better than 12 years service.

Problem 15

Material Used: Steel straight run fractionating tower and trays. The trays were 3/8-in. thick and lasted only a year and the shell was severely pitted after two years. The severest condition was in the uppermost section of the tower.

Service Conditions: Crude oil being processed with a gravity of 20 to 26. The sulfur content varied from 1.3 to 2.5 and the salt content from 15 to 30 lb per 1000 bbl. The total sulfur in the gasoline varied from 0.12 to 0.40 per cent. The temperature at the top of the tower was maintained at 300 to 340 F and 18 per cent gasoline was being produced.

☆ ☆ ☆

Discussion: Corrosion in the top sections of atmospheric crude distillation units arises chiefly from hydrochloric acid either formed by hydrolysis of chloride salts, especially calcium and magnesium chloride, entrained in the crudes, or added by the acidizing of wells. Despite the customary practice of settling the salt water from crudes, and in some cases the use of special desalting processes, there still appears to be enough salt water dispersed in such crudes to result in the formation of an acid condition. Corrosion is mitigated in some cases by injection of ammonia into the distillation system to neutralize part of the acid, but experience would indicate that this frequently is not an adequate solution to the problem.

It is probable that with salty charging stocks, maximum hydrolysis of magnesium and calcium chlorides occurs in the hottest region at the bottom of distillation towers, however, maximum acid corrosion occurs in the top portion of such towers, in reflux and distillate condensers, coolers and accumulators, and in reflux and run-down lines, where temperatures are low enough for an aqueous acid phase to condense. Maximum corrosion by sulfur compounds will, on the other hand, occur in the higher temperature ranges in the bottom portions of distillation towers and in crude heaters. As the alloys most resistant to acid corrosion frequently are not resistant to high temperature sulfur attack, it is common practice to line the top and bottom portions of distillation towers with different materials to obtain most favorable performance.

Numerous corrosion tests have been made on or above the top plate of atmospheric crude distillation towers in a number of refineries in different geographical locations and the following results are typical of those representing probably some of the worst conditions involving the processing of West Texas crude. The specimens were exposed for 60 days to the straight run gasoline vapor at the top of the tower maintained at an average temperature of 250 F.

Material	Indicated corrosion rate-inch penetration per year	Max. pitting during Test-in
Monel	0.0031	None
Nickel	0.0057	0.013
Inconel	0.017	0.016
Type 302 S.S.	*	—
Type 304 S.S.	*	—
Type 316 S.S.	0.053	0.001
5 per cent nickel steel (SAE 2512)	*	—
Mild steel	*	—
Ni-Resist	0.051	None
Cast iron	0.181	Graphitized

* Specimens of Types 302 and 304 stainless steel and 5 per cent nickel steel, originally 0.031 in. thick, and mild steel, 0.062 in. thick, were completely destroyed during test period.

The test data indicate that mild steel as well as the 18-8 types of stainless steel, 5 per cent nickel steel and cast iron are definitely unsuitable under these conditions. It is apparent also that nickel and Inconel are not adequate because of their susceptibility to severe pitting attack. The Type 316 stainless steel showed a reasonable corrosion rate and while the depth of local attack was rather insignificant, this tendency nevertheless exists and it has been noted to be much more serious under similar circumstances. Of the remaining materials, Monel proved to be outstanding from the standpoint of resistance to both general corrosion and pitting. Because of this fact, it has been adopted to a considerable extent as a lining or as a Monel-clad steel shell for upper tower sections, reflux and distillate accumulators and condenser shells, and in some cases for reflux and run-down lines. It is also used for fabricated bubble caps, plates, and fittings in upper tower sections.

These problems are typical of many that have been encountered with corrosion of refinery processing equipment and as demonstrated they can often be solved by referring to available information and data obtained by an experienced corrosion engineer under the same or similar conditions. On occasion a situation is involved whereby no clear cut answer to the problem is evident because of the lack of either practical experience and/or available data and under these circumstances it is necessary to resort to the use of spool-type specimen holders for such information as may be obtained. The advantageous use of these assemblies should be encouraged once the details of the problem are established and a check on the sources of existing data discloses no pertinent information under the particular set of corrosive conditions that might be used as a basis for selecting suitable metals and alloys for the environment in question. ★ ★ ★

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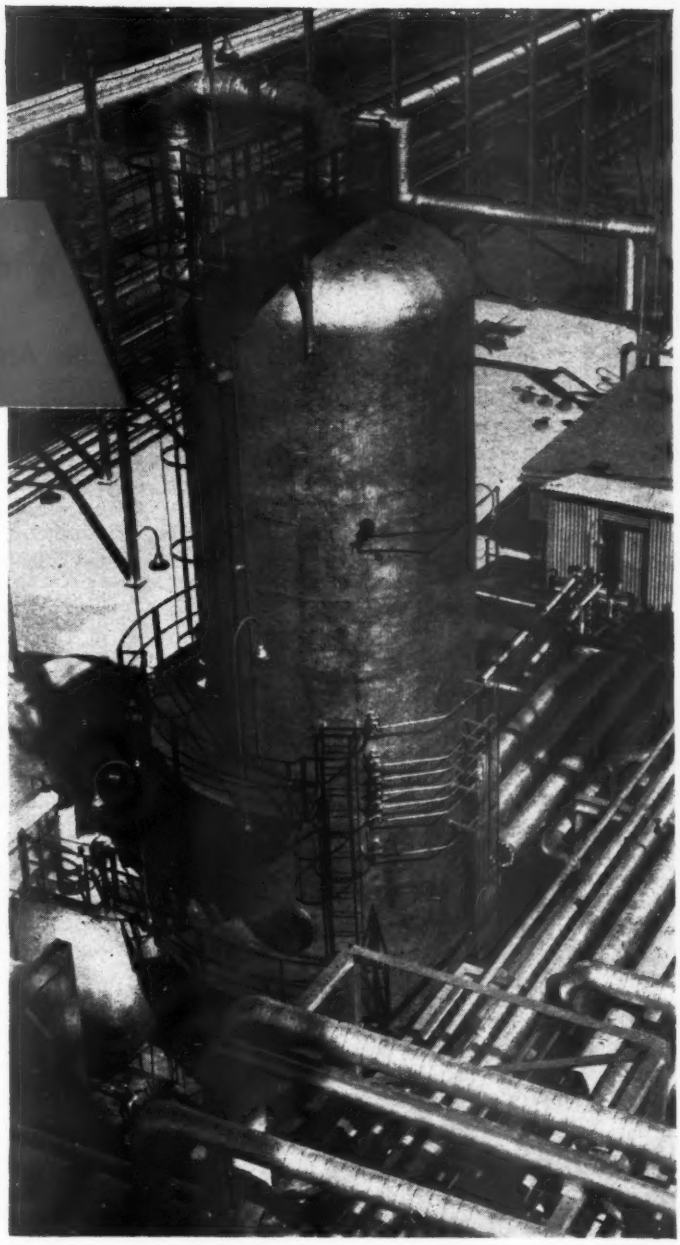

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Mechanical Seal Retaining Assemblies†

Troubles with mechanical seal installations and the methods employed to correct them

LOUIS T. ELLIS, JR. AND CLAUDE L. FUSSELL

A SERIOUS and widespread weakness in mechanical seal installations has been found to exist on centrifugal pumps that were originally designed for soft packing. A bolting failure on such an installation has caused a large fire at one of the refineries of the Esso Standard Oil Company, and a similar failure, which resulted in a serious gas release, is known to have occurred at another refinery. The weaknesses found on the installations that failed and on other pumps since that time at these refineries may exist at other plants where soft packing has been replaced with mechanical seals without adequate engineering design. It is hoped the information that follows concerning one Esso refinery may enable other plants to avoid failures due to weaknesses in mechanical seal retaining assemblies.

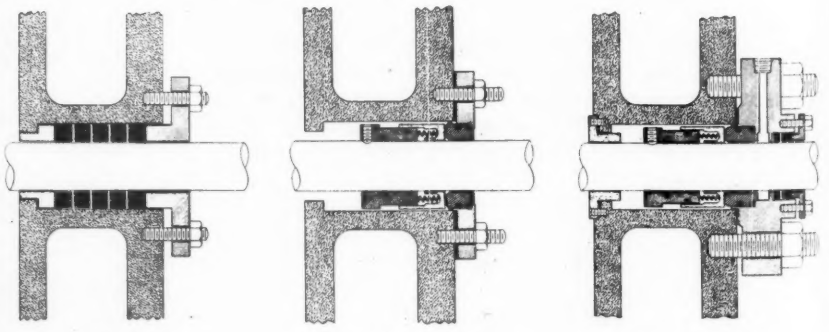
Although mechanical seals were used on a limited basis at this refinery as early as 1938, their broad use did not begin until 1947. Since that time approximately 350 seals of various types have been installed on centrifugal pumps in services ranging from propane to crude oil. Most of these seals were installed at the refinery as replacement for soft packing without due consideration being given to the design of the holding members. Seal gland plates were generally patterned after the packing glands for particular pumps insofar as thickness and diameter were concerned, and the original bolting provided for soft packing was often reused for retaining the mechanical seal. (See Fig. 1). Typical mechanical seals require the seal gland plate to be attached to the pump case in a leak-proof gasketed joint. (See Fig. 2). Bolting sufficient to retain soft packing in a stuffing box is usually many times too weak to properly yield and seat the normal compressed asbestos gasket installed. In addition, a seal gland plate similar in thickness and diameter to a packing gland is usually far below the design standards for the stresses imposed by a gasketed joint under internal pressure, and such a seal gland is very often not sufficiently rigid to avoid misalignment of the seal face.

During 1950, failure of the bolting retaining the mechanical seal on a propane pump caused a large gas release and flash at one of the light ends plants. Fortunately no personnel were injured. The pump involved in this fire was a 9-stage 600 gpm centrifugal pump with a suction pressure of 350 psig and a discharge pressure of about 1200 psig. The soft packing originally installed was replaced by the field mechanical forces with a mechanical seal utilizing the practices outlined in the preceding paragraph. The throat bushing that is normally found in such installations (see Fig. 2) was left out of this pump. With the mechanical seal and bushing out, an annular opening of 5/16-in. width existed around the pump shaft through which a flow in excess of 72,000 bbl per day could be expected with 350 psig differential pressure. Following the fire, calculations indicated that in order to properly seat the wide full face compressed asbestos gasket installed between the seal gland and the pump, the three 18-8 chrome nickel studs would have been under a load of 101,000 psi. The ultimate tensile strength of this type stud is 75,000 psi. Instead of the three bolts actually installed on this pump, 20 bolts of the same material and size would have been necessary to lower the bolt stress to within the maximum allowable limit (see Fig. 3). This retaining assembly was redesigned utilizing a seal gland with a raised face, a narrower gasket and five high strength bolts (ASTM Specification A-193 Grade B-7).

Preliminary engineering checks of the retaining assemblies on other mechanical seal installations were made soon after the fire. These checks indicated that virtually all of the mechanical seal installations were below the minimum standards given in the flange design section of the API-ASME Code for Unfired Pressure Vessels, 1943 edition.

On the basis of these findings, a program for checking, redesigning, and modifying all seal equipped pumps was begun. The initial design practices followed in this work called for the use of high strength bolting, raised face gasket surfaces, throat bushings, and seal gland plates and bolting sized in accordance with the requirements given in the API-ASME and ASME Codes for Unfired Pressure Vessels. A minimum of three bolts attaching the seal gland to the pump was considered desirable to provide for failure of one bolt without complete failure of the joint, but it was found impractical to adhere to this rule because of the many horizontally split case pumps with two bolts. Major alterations to the cases of these pumps would be necessary to provide more than the two existing bolts. In actual practice two bolts are allowed for the

FIG. 1. Stuffing box installation.
Conversion from soft packing to mechanical seals.



Typical soft packing installation.

Soft packing replaced with mechanical seal using same size gland and bolting.

Mechanical seal retaining assembly after strengthening.

†Presented before the sixth annual Petroleum Mechanical Engineering Conference—American Society of Mechanical Engineers, Tulsa, Oklahoma, September 24-26, 1951.

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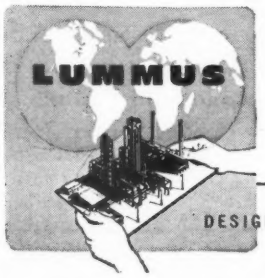

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DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

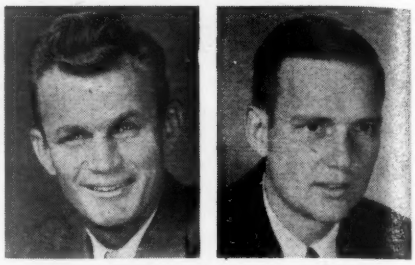
redesign of existing installations if the required total bolting strength is provided.

Bolt loads are determined from standard formulas that are given in both the API-ASME and ASME Codes for Unfired Pressure Vessels. The first of these formulas determines the bolt load necessary to withstand the hydrostatic end force due to internal pressure and that required to maintain a compression load on the gasket sufficient to assure a tight joint. The second formula determines the initial bolt load necessary to seat the gasket under atmospheric conditions in the absence of internal pressure. The larger of the values determined from these formulas is used for establishing required bolting. In most pump installations the second formula governs. This formula contains a gasket unit seating load factor that directly affects the size and number of bolts required. The API-ASME Code (1943 edition) suggests a value of 4500 psi for this factor for all thicknesses of compressed asbestos gaskets, while the later editions of the ASME Code suggest graduated values depending on thickness and beginning with 1600 psi for ⅛-in. thick gaskets. Because it is difficult to provide sufficient bolting area on most pumps and because the graduated values represent the latest opinions on the subject, the more liberal ASME graduated values are used for bolting calculations.

The decision to use high strength bolting material necessitated the determination of proper thread engagement for dissimilar metals. Frequently, the pump on which B-7 studs are used are cast iron, brass or other low strength materials. With these metals it was found that the commonly used depth for tapped holes of one nominal bolt diameter made the pump threads considerably weaker than the bolting. In order to insure that the pump threads will be at least as strong as the bolting, the required depth for the various metals used is determined by equating the tensile strength of the bolt to the shear strength of the threads of the weaker material. These depths are converted to nominal bolt diameters for use in the shop. In instances where it is suspected that excessive stresses may be set up in the pump case by larger bolting, the actual stresses involved are calculated to insure that they are within the limits of the strength of the pump case material. Most of these instances have involved the possibility of the through-bolt in an eye-bolt assembly shearing the pump case.

At the time the redesign program was begun many thin seal gland plates were known to have bent an amount sufficient

The Authors



L. T. Ellis, Jr. C. L. Fussell

Louis T. Ellis, Jr. received a BS degree in electrical engineering from Harvard University in 1944. He served in the Navy and returned to the Harvard Business School from which he received an MBA degree in 1948. He was employed by the Esso Standard Oil Company, Louisiana division, in 1948 as an engineer in the equipment inspection department. In this capacity he served for two years as engineering inspector on process units and in the shops. Ellis was formerly head of the shop inspection group responsible for the checking, redesigning, and altering of mechanical seal retaining assemblies on centrifugal pumps, and at the present time is a member of the process engineering department.

Claude L. Fussell was graduated from Louisiana State University in 1949, with a BS degree in electrical engineering. Since that time he has been employed as engineer in the equipment inspection department of the Esso Refining at Baton Rouge, Louisiana. In this capacity, he has served as engineering inspector on process units for two years and as metal and maintenance inspector in the refinery mechanical shops during the past six months. In the latter capacity, he has been responsible for preparing a design standard and checking and redesigning the mechanical seal retaining assemblies on centrifugal pumps.

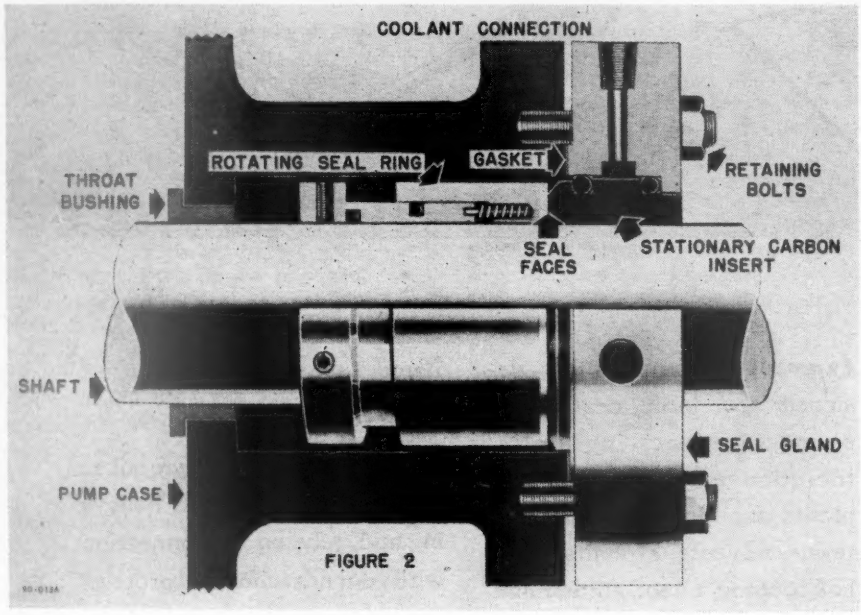


FIG. 2. Typical mechanical seal installation.

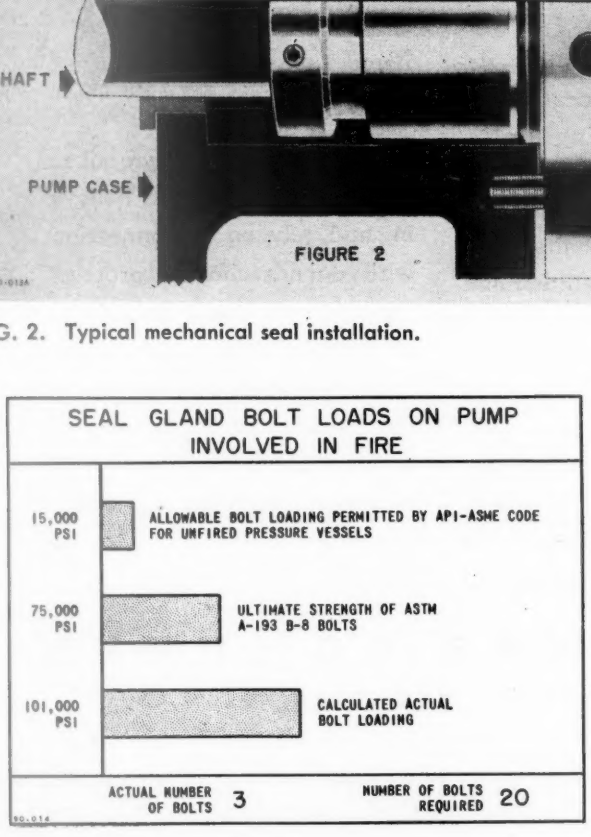

SEAL GLAND BOLT LOADS ON PUMP INVOLVED IN FIRE
15,000 PSI
ALLOWABLE BOLT LOADING PERMITTED BY API-ASME CODE FOR UNFIRED PRESSURE VESSELS
75,000 PSI
ULTIMATE STRENGTH OF ASTM A-193 B-8 BOLTS
101,000 PSI
CALCULATED ACTUAL BOLT LOADING
ACTUAL NUMBER OF BOLTS 3
NUMBER OF BOLTS REQUIRED 20

FIG. 3.

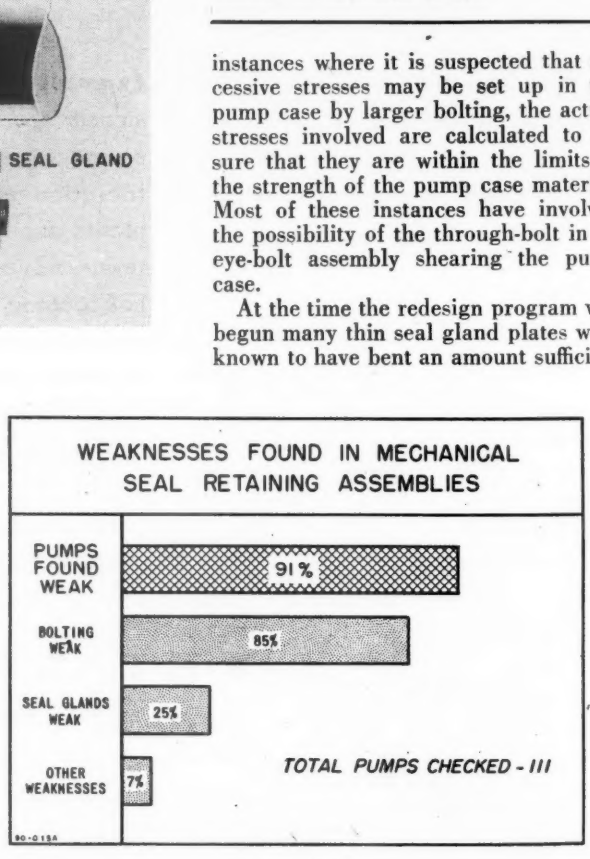


FIG. 4.

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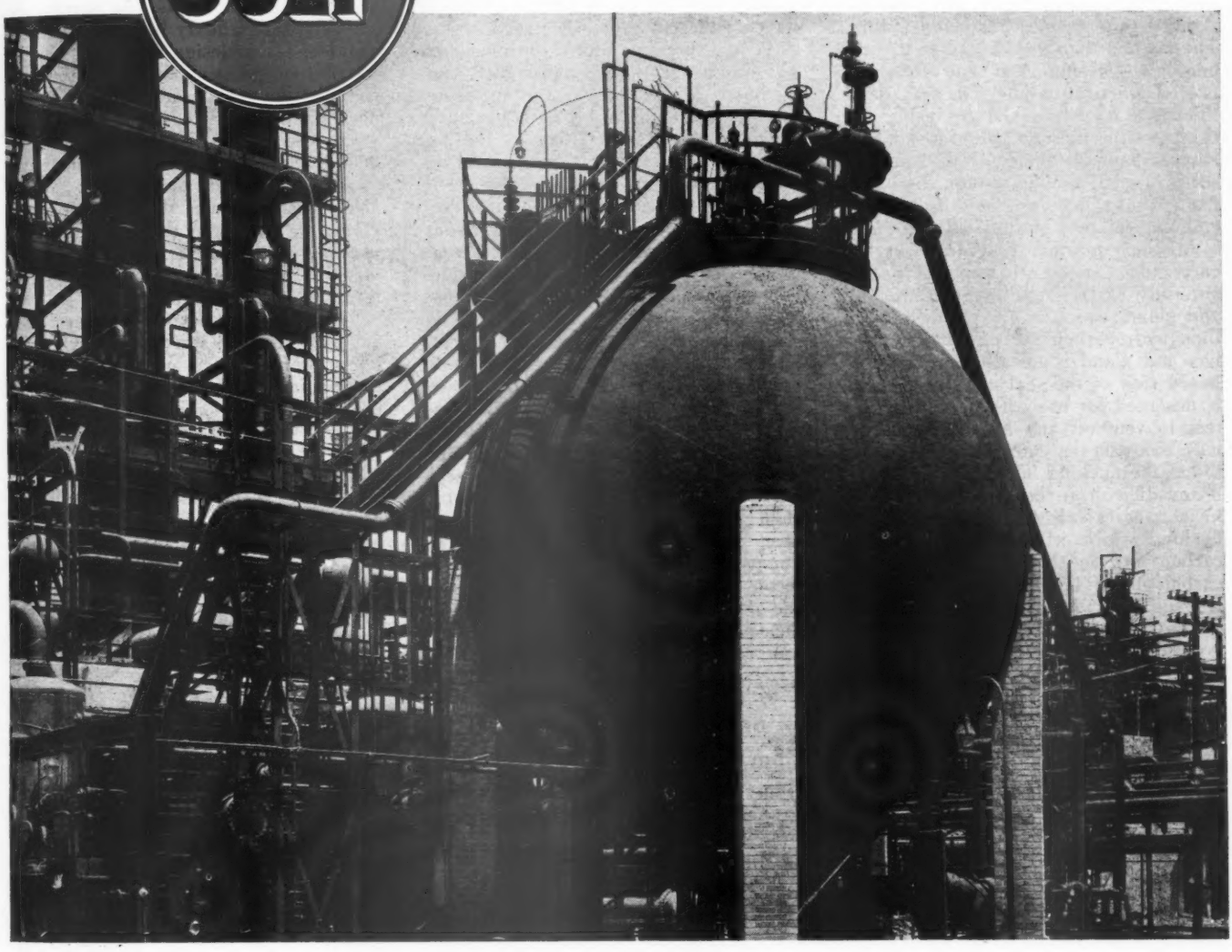

The Petreco Electrosphere Desalter illustrated above is one of eight separate Petreco installations in the Gulf Oil Corporation refinery at Port Arthur, Texas. Gulf also uses Petreco Desalters in its refineries at Philadelphia and Pittsburgh, Pennsylvania, Toledo, Ohio, and at Fort Worth and Sweetwater, Texas. These repeated installations by a refiner with Gulf's acknowledged leadership and refining know-how speak for themselves. If you want the best in desalting equipment, engineering, service and performance—specify PETRECO. Assure your refinery of more economical operations with

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to cause gasket leakage or carbon insert failure. This problem was particularly evident on two-bolt, oval shaped seal gland plates. The exact amount of bending that will cause carbon insert leakage or failure is difficult to determine. Some practical and quick means had to be found, however, to establish seal gland thicknesses of sufficient rigidity to prevent leakage or failure. The method that was chosen at this refinery is an empirical one that has proved practical to date. The seal gland thickness is determined by using the thickness through the hub of a standard slip-on flange, which is of the same series rating as the pump discharge flange, and which has a bolt circle diameter nearest that of the seal gland.

Another question that arose in the early stages of the program was the desirability of the auxiliary stuffing box and gland, which is often provided for light hydrocarbon pumps. This stuffing box and gland is installed on the outboard side of the seal gland plate and is designed for use with a venting system to vent off any hydrocarbon that may leak past the seal. This refinery has found the packing in auxiliary stuffing boxes difficult to keep lubricated and in most cases substitutes a close fitting bushing which will retard the hydrocarbon flow in the event of complete carbon insert failure rather than vent leakage. This bushing is in addition to the normal throat bushing.

A design standard covering all of the specific parts of retaining assembly design was written and is being used for the modification of existing pumps and for the purchase of new pumps. It is appreciated, however, that the design of retaining assemblies for mechanical seal installations is in the development stage. Revisions to this standard will be made as further study and plant experience indicate that they are necessary.

At the present time approximately 111 pumps have been redesigned and modified. Ninety-one per cent of these pumps were found to be under-designed in some respect. (See Fig. 4.) Bolting has been the major weakness found on most pumps. Approximately 85 per cent of the installations checked have required more bolting strength and about 25 per cent have required thicker seal glands. Horizontally split case pumps with two-eye bolts have proved the most difficult to redesign because the use of more than two bolts is usually impractical and the required size eyebolt sometimes necessitates enlarging the space in the pump case for the eye. Compressed asbestos gaskets 1/16 in. thick are generally used in conjunction with a raised face for attaching the seal gland to the pump case, although metal clad gaskets and confined gaskets have been used in some instances. Several pumps with mechanical seals have been reconverted to soft packing because the use of a mechanical seal did not justify the cost of the excessive corrective measures necessary.

Insuring against retaining assembly failure cannot end with the providing of proper design. The mechanics who regularly assemble and disassemble these installations must have enough knowledge of the retaining assembly problem not to weaken the installation by the substitution of different materials or different size parts. To meet this problem, this refinery has given all mechanical seal redesign information wide distribution particularly among the mechanical forces. In addition the engineers handling the redesign calculations work closely with the shop mechanical people on all seal alterations and have assisted in the field on many occasions. Experience indicates that the mechanical forces recognize the importance of proper seal installations and are willing to call in the design engineers before making any changes.

The weaknesses existing in mechanical seal retaining assemblies at this refinery were pointed out by a serious bolting failure. As a result of this failure, other refineries of the Esso Standard Oil Company have checked many of their pumps and discovered the same underdesigned installations. It is probable that such weaknesses exist in plants of other companies where soft packing has been replaced by mechanical seals without complete engineering checks. Further failures can be prevented by the discovery and correction of these weaknesses.

* * *

Job Order Record for Field Office Materials*

JOHN P. TUCKER†

Purpose: For field office to be able to keep up with material ordered and received on jobs they are handling.

The purpose of this job order record is for the field office to have a record of material that has been ordered, and from whom, as well as to be able to check with the home office and refer to the items in question by EPO or Purchase Order Number. This we find avoids unnecessary delays, mistakes and saves considerable time.

The original or a copy of all tickets of any kind for purchase of material to be charged to this job order, should pass over the desk of the clerk handling this work and should be entered and initialed by him.

The first ticket received covering material should be entered, whether the ticket be a merchants sales ticket, EPO, Purchase Requisition, Warehouse Order or Field Transfer. Then the date and number of any subsequent tickets that come through, on this material, should be recorded on the same line with the original entry, thereby condensing all information regarding any material.

When material charged to this job order is used on another job or transferred to stock, a Field Transfer Ticket should be run through, crediting the job order and charging the material to the proper account.

Under the column "Received" the Date and By should always be filled in. When items are received by a person, initials are usually used. Some material comes by freight, express, mail or truck; clarify the "By" as much as possible.

The space provided for "Price" is simply a memorandum, to be used if desired and when convenient. This record is not intended to take the place of cost accounting but it is often a help to the cost accountant in clarifying the disposition made of some material.

*NGAA Second Prize—Class D.

†Chief clerk, Arkansas Fuel Oil Company, Longview, Texas.

JOB ORDER NO. 350 DATED 2/10 1951

DESCRIPTION OF WORK Install 50 HP Gas Engine on line No. 2, etc.

REMARKS

Ordered from		List material	Merchants sales ticket		E. P. O.		Purchase: Requisition		Purchase: Order		Del. date req.	Warehouse: Order		Warehouse: Charge ticket		Credit ticket		Field transfer		Received		
			Date	No.	Date	No.	Date	No.	Date	No.		Date	No.	Date	No.	Date	No.	Date	No.	Date	By	Price
WO	10	2 x 6 Nipples	..	..	..	..	..	..	..	..	..	2/17	1244A	2/21	6650B	..	..	..	..	2/17	HB	..
WO	100′	2″ PE Pipe	..	..	..	..	..	..	..	..	..	2/17	1244A	2/21	6650B	3/15	FT#325	..	..	2/17	HB	..
Engine Co.	1	50 HP etc. GE	..	..	..	..	2/20	1115	2/27	1384	5/1	..	..	..	..	..	..	..	..	5/12	HB	..
Hardware Co.	1	Water can	2/22	188	2/23	1000	..	..	..	..	..	..	..	..	..	..	..	..	..	2/22	HB	..
FT	200′	1″ black pipe	..	..	..	..	..	..	..	..	..	..	..	..	..	3/3	JO-332	3/3	1710	3/3	HB	..

E.P.O. Emergency Purchase Order
WO Warehouse Order
WCT Warehouse Charge Ticket
FT Field Transfer
JO Job Order

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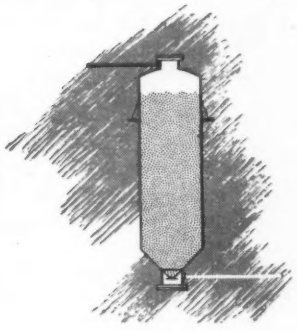

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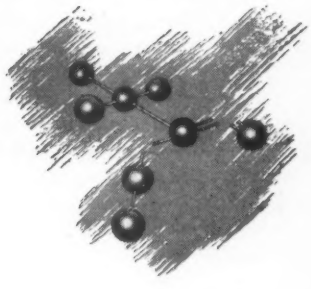

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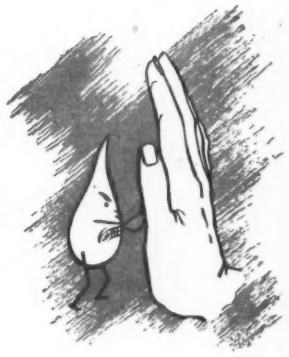

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THE TECHNICAL FORUM

Fin Tube Heat Transfer Calculations

Q I will greatly appreciate your being so kind as to inform me analytically the practical form of calculating the coefficients of heat transmission for gas coolers (refrigerators) of the Fin-Fan type when fin tubes (tubes with fins) are utilized.

A method is required that contemplates all the variables that affect the coefficients.—A. C.

A Extended heating surfaces, or finned tubes are used in heat exchange when the thermal resistance of one fluid to heat flow is greater than that of the other fluid. They are recommended when heating or cooling gases, fluids of high viscosity or fluids moving at low rates of flow. For example, when heating air with condensing steam, the greater thermal resistance is on the air side. Thus, the use of an extended surface, or "fins" on the *air side* will effectively increase heat transfer.

Derivations of equations for calculation of heat transfer rates using extended surfaces become somewhat complicated from a mathematical standpoint. Fortunately, however, a number of investigators have explored possibilities using various types of extended surfaces, and integrated, usable equations or graphical correlations are available. Perhaps the most common type of extended surface is the longitudinal fin. Consequently detailed discussion concerning the present question and example calculations will be based largely on the use of longitudinal fins of constant thickness.

Section views of this type of extended surface are shown in Figs. 1 and 2. (The specific dimensions refer to a later example.) The total heat transfer to the finned tube from the fluid flowing outside the tube is the sum of (1) the heat flowing into the fins and thence through the tube to the inner fluid, plus (2) the heat flowing through the tube at its outside diameter. There is an unequal heat flux on the outside surface of the tube since there is a greater heat flux just beneath the base of each fin. Due to the high thermal conductivity of the tube metal, however, the heat flux is considered to be uniform at the inner surface of the tube.

Commonly, heat transfer coefficients are based on outside surface, however, in light of the above reasoning it is seen that the heat transfer coefficient of the outer fluid should be based more logically on the inside surface of the tube.

Referring to the table of nomenclature, the equation relating h_f and h_{f_i} has been found, by a number of investigators, to be of the type:

$$h_{f_i} = \frac{h_f\,(EA_f + A_o)}{A_i} \quad . \quad . \quad (1)$$

It is felt that all terms except E are self-explanatory. The value E, defined by $\frac{\tan h\,(xl)}{xl}$, is in the final analysis the "efficiency" of heat transfer through the fins, compared to the efficiency of heat transfer through the same area of pipe at its outside surface. This perhaps becomes more apparent on examination of Equation (1), where it is seen that A_f is multiplied by E before being added to A_o.

It should be re-emphasized at this point that Equation (1) pertains *only* to use of longitudinal fins of constant thickness. To illustrate this equation calculations are made for a concentric tube exchanger in Example 1.

Example 1: A 1-in. OD, 10 BWG steel inner tube with 10 equally spaced fins, each 18 BWG, 7/8 in. high, is to be used

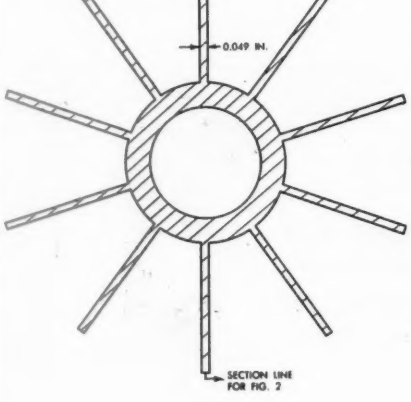


FIG. 1. Cross-section of tube using extended longitudinal fins.

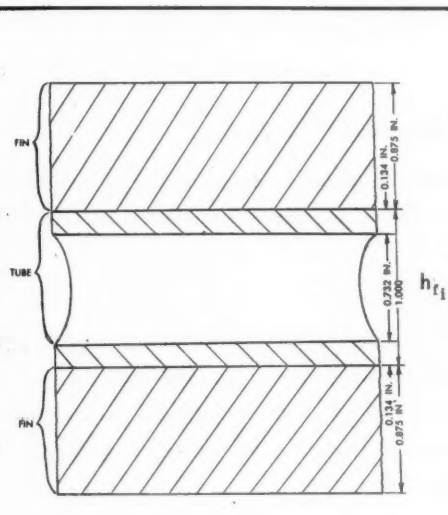


FIG. 2. Longitudinal section of tube using extended longitudinal fins.

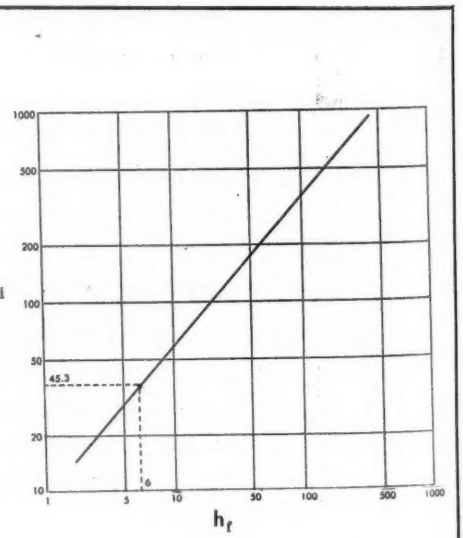


FIG. 3. h_{f_i} versus h_f for conditions of Example 1.

with a standard 3-in. steel pipe. Values of h_f and h_{f_i} will be compared at a reasonable value of h_f.

It should be noted at this point that h_f is calculated by the usual procedure for a fluid flowing through an annulus. Thus, a reasonable value for h_f will be chosen here as a basis for the calculations. A value of 6 will be used.

Solution: Basis: $h_f = 6$ BTU/hr — ft² — °F; calculations to be made on 1 ft of exchanger length.

$$A_o = \text{bare tube surface} = \left(\pi \times \frac{1}{12} - 10 \times \frac{0.049}{12}\right) = 0.221 \text{ ft}^2/\text{ft}$$

$$A_f = \text{fin surface} = 10 \times \frac{0.875}{12} \times 2 = 1.46 \text{ ft}^2/\text{ft}$$

$$A = A_f + A_o = 1.46 + 0.22 = 1.78 \text{ ft}^2/\text{ft}$$

$$A_i = \text{inside surface} = \frac{\pi \times 0.732}{12} = 0.192 \text{ ft}^2/\text{ft}$$

$$x = \left(\frac{2h_f L}{ka^1}\right)^{1/2}$$

$k = 26$ BTU/hr — ft² — °F/ft

$h_f = 6$ BTU/hr — ft² — °F

$$a^1 = \frac{0.049}{12} \times 10 \times 1 \text{ ft}^2$$

$L = 10 \times 1 = 10$ ft/ft

$$x = \left(\frac{2 \times 6 \times 10}{26 \times 0.049 \times 10/12}\right)^{1/2} = (113)^{1/2} = 10.62$$

$$l = \frac{0.875}{12} = 0.073 \text{ ft.}$$

$$lx = 10.62 \times 0.073 = 0.775$$

$$\tan h\ (0.775) = 0.651$$

$$E = \frac{\tan h\ (0.775)}{0.775} = \frac{0.651}{0.775} = 0.840$$

$$h_{fi} = \frac{h_f[EA_f + A_o]}{A_i} = \frac{6(0.840 \times 1.46 + 0.221)}{0.192}$$

$$h_{fi} = \frac{6[1.45]}{0.192} = 45.3 \text{ BTU/hr} - \text{ft}^2 - {}^\circ\text{F}$$

Note that the area to be used with h_{fi} to calculate q should be A_i.

It should be noted that as h_f increases, the value of E decreases, since the temperature of the fin becomes closer and closer to the gas temperature. Fig. 3 shows approximately the relationship between h_f and h_{f_i}, as h_f increases for the case calculated above. Of course, as h_f increases, the need for finned tubes becomes less and less.

The use of fins of other shapes than that described above would, of course, alter the calculation method. If specific information on some other shape is desired, an additional request, accompanied by a sketch showing proper geometrical relationships is recommended.

G. L. Farrar

TABLE OF NOMENCLATURE

h_f = film coefficient from outside fluid to fin side, to both film surface and tube surface, BTU/hr—ft²—°F

h_{f_i} = value of h_f, referred to the inside tube surface, BTU/hr—ft²—°F

A_o = bare tube surface at the outside diameter, ft² (Note: this excludes the area of contact of fin with pipe)

A_i = Inside tube surface, ft²

A_f = Total surface area of fins, including both sides of each fin, ft²

A = Total outside surface, ft²

$E = \dfrac{\tan h \times xl}{xl}$

l = length of fin, from base to outer edge, ft

$x = \left[\dfrac{2h_f L}{ka^1}\right]^{1/2}$

L = total length of the fins, direction parallel to flow, ft.

k = thermal conductivity of the metal, BTU/hr—ft²—°F/ft

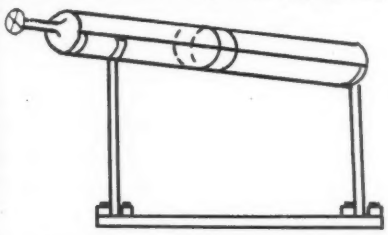
a^1 = cross sectional area of all fins, at right angles to heat flow, ft².

* * *

PLANT AIDS

Reinstalling Fire Extinguishers In Trucks, Etc.

In many installations fire extinguishers are placed rigidly in a "tight" corner, may be bracketed tightly and may tend to "freeze" in place and require considerable force to remove when desired. A new rack or cradle is installed as indicated in the drawing, with spring clips

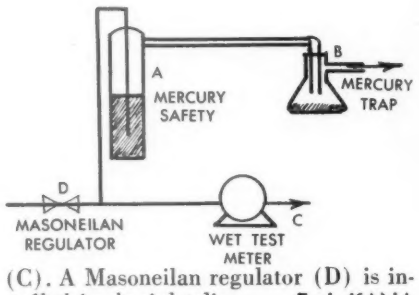


fore and aft or the equivalent retainer means, in a convenient location in a horizontal position ready for instant removal and use.

R. H. HIX

Mercury Traps in Tail Gas Line

A mercury safety (A) is installed in the tail gas line of a treating unit, which mercury is blown out on occasion. To save the mercury a trap (B) has been installed on the discharge side of the mercury safety tube, so arranged that it catches and retains all mercury blown out without interfering with the operation of the safety (A) or the test meter

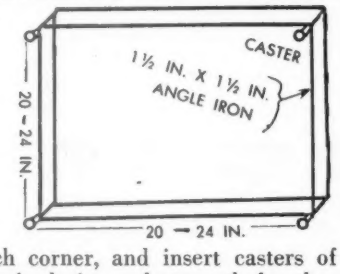


(C). A Masoneilan regulator (D) is installed in the inlet line.

F. J. KANA

Dolly for Heavy Objects

A 4-caster square dolly for handling barrels, furniture, etc., may be made by welding four 1½-in. by 1½-in. angle iron pieces of the desired length in a square with the lower flange flat and horizontal. Then weld a caster base at

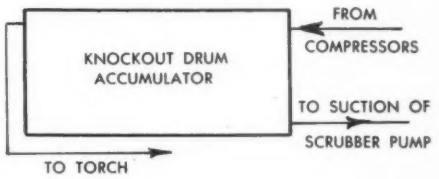


each corner, and insert casters of the required size and strength for the purposes to which the dolly may be put.

J. L. SHAW

Knockout Drum in Waste Gas Torch Line

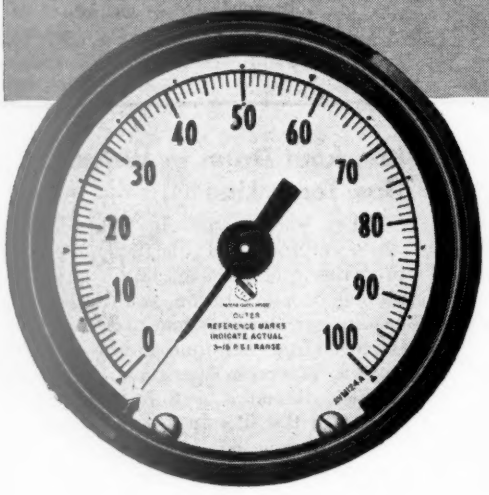
When compressors in light oil and vapor service stand idle they collect appreciable quantities of liquid gasoline; in one booster station installation this gasoline of necessity had to be vented to the torch line each time an idle compressor was placed in operation. A cylinder six feet diameter by 8 ft long was installed in the line from compressors to



the torch through which the vapor and liquid is vented. The line from compressors to knockout drum, and that from the drum to the torch enter and exit, respectively, near the top element of the drum. Another line from the lower level of the drum to the scrubber pump suction enables the operator to withdraw the liquid caught in the drum at will.

W. R. EBERHARDT

This plant aid submitted through courtesy of the Humble Oil and Refining Company's Coin-Your-Ideas Plan.



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Electron Microscope Study of Lithium Greases†

Relationships between composition of greases and their performance when worked and in service.

JOHN A. BROWN, CHARLES N. HUDSON, LEWIS D. LORING

In recent years the electron microscope has become a very useful and important tool in the study of lubricating greases, and a number of workers have used this tool to explore various grease problems.[1,3,4,9,11,12,14] Detail of the soap fiber structure can be obtained by no other means in use at the present time. The resolution of the optical microscope is not sufficient to reveal the detail of the soap fiber structure. X-ray diffraction gives information about unit crystals in detail much finer than the size of the fibers. The electron microscope fortunately is able to bridge the gap to reveal the fine detail of the fiber structure.

The technique of preparing specimens for the electron microscope[7,12] is somewhat different from that used in optical microscopy as specimens and specimen supports must be very much more than for electron microscopy.

The procedure used in our laboratory for preparing specimens is as follows: A section of specimen screen (200 mesh to the inch) is covered with a thin film of formvar (an organic plastic material) as is normally done in electron microscopy. A small amount of grease is vigorously agitated in a large amount of ASTM naphtha to give a fairly dilute dispersion. One or two drops of this suspension are placed on the specimen screen carrying the plastic film and allowed to dry. The preparation is then washed with ASTM naphtha. The specimen in this condition would provide any detail if viewed directly on the electron microscope as there is not enough contrast inherent in the soap itself. Therefore, a technique called shadowcasting is used,[15] in which a very thin film of a heavy metal is evaporated on to the specimen at an oblique angle, and the sample is then examined in the electron microscope. This method enhances detail on the fiber surfaces and also provides a permanent shadow from which information about the third dimension of the sample can be obtained. Chromium metal is used in our laboratory for shadowing purposes since it gives consistently good results with a smooth background and does not become granular in the manner of gold and some other metals when subjected to the electron beam in the microscope.

Some doubt has been raised as to whether the fiber structure revealed by this method is the true structure or whether it has been modified in the sample preparation process. Several experiments indicate that the process is a legitimate one and that the fiber structure revealed by the electron microscope is the true structure.

In order to prove this point a lithium grease was examined by spreading a very thin film of the grease on to a specimen support and shadowing without use of naphtha at any time. The fiber structure although poorly resolved, (Fig. 2) was shown to be the same as that obtained by the solvent leaching method (Fig. 1). (Magnification marks on all micrographs in this paper are equal to 1 micron (u) which is .0001 cm. in length. Also 1 Angstrom unit (A) is .00000001 cm.

X-ray diffraction examination shows that the crystal structure of the soap is the same whether in the oil environment as in a grease or in the leached state free of oil as when prepared for examination in the electron microscope. Although this is not positive proof that the fibers themselves maintain the same size and shape in the leached condition that they had in the grease, it suggests that this is the case.

Greases that have been made by different methods but from the same components sometimes show completely different structures when examined by the electron microscope. Chemically these greases are the same, the only difference being that of the physical state of the soap component. Hence, the electron microscope reveals differences where chemistry does not. This is an important application of the electron microscope to grease problems as it enables one to examine the effects that process variables, testing procedures, and actual mechanical work have on the fiber structure.

These data indicate that the electron microscope is a useful and legitimate tool for grease examination and that the method of preparation has not appreciably altered the fiber structure.

†Presented before National Lubricating Grease Institute, Chicago, Illinois, Oct.

The Authors

John A. Brown is electron miscroscopist and physical chemist for Sinclair Research Laboratories, Inc., Harvey, Illinois. He began his technical education at Loyola University, which granted him a BS degree in chemistry in 1940; spent two years as physical chemist with

Charles N. Hudson

L. D. Loring

International Ink Company, then four years as radar technician with the Army Air Corps, 1942 to 1946.

Charles N. Hudson graduated from the Missouri School of Mines in 1948 with a BS in chemical engineering, after three years with the Armed Forces in the European Theater and elsewhere. He is a member of Alpha Chi Sigma, Tau Beta Pi, and Phi Kappa Phi, professional and scholastic fraternities.

L. D. Loring graduated from Tufts College with a BS in chemical engineering, in 1941. The Navy took up five years for him, as ordnance officer and then he joined Sinclair's research department and has been active in grease research.

Grease Structure, Optical Birefringence, Orientation

The optical microscope as well as the electron microscope has aided in revealing the bulk structure of greases. It is generally known that greases are colloidal systems of solid soap fibers and liquid oil. These systems set up into a gel structure with certain definite rheological properties. It is this gel structure that is worthwhile investigating as it largely determines the physical characteristics of the bulk grease.

If a grease is spread onto an ordinary microscope slide and is then examined under polarized light, it is noted that the whole grease mass acts as a single crystal of a double refracting or birefringent nature. This phenomenon of birefringence is exhibited by any crystal that has two different indices of refraction along the different crystallographic axes. All but the simple cubic crystals possess this property. Birefringence is detected by examining the material under polarized light between two crossed Nicol prisms. As the crystal is rotated in polarized light it becomes alternately light and dark. This is a common microscopic method of crystal examination.[6] Crystals

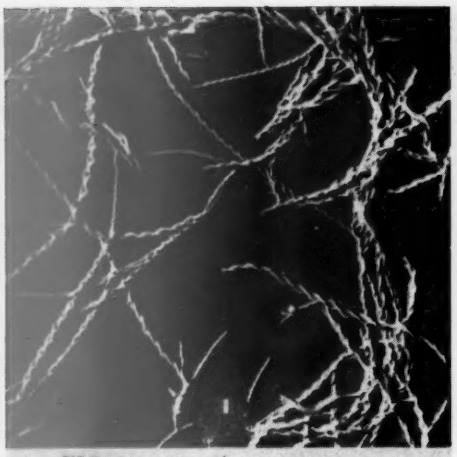

FIG. 1

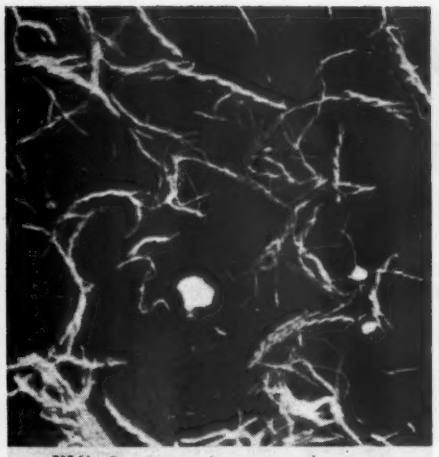

FIG. 2

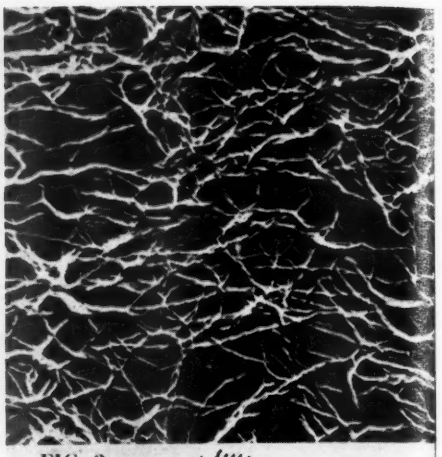

FIG. 3

FIG. 4

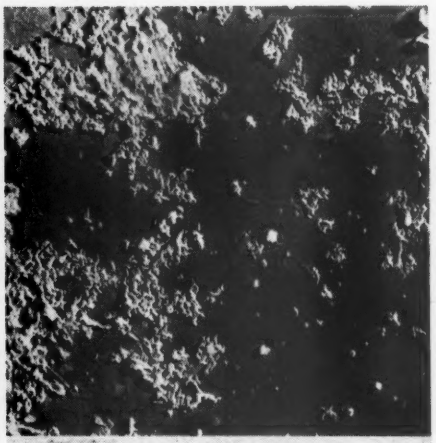

FIG. 5

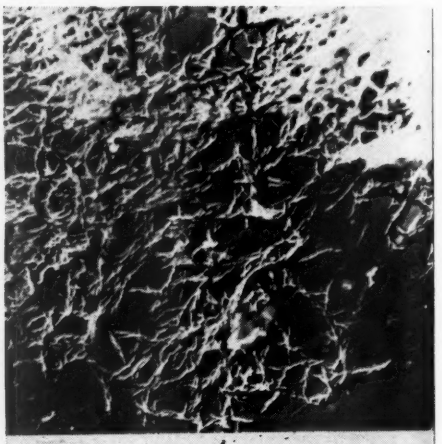

FIG. 6

FIG. 7

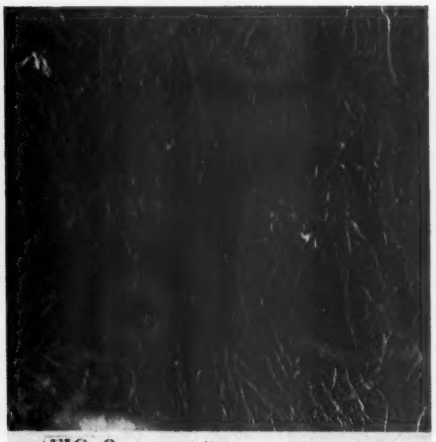

FIG. 8

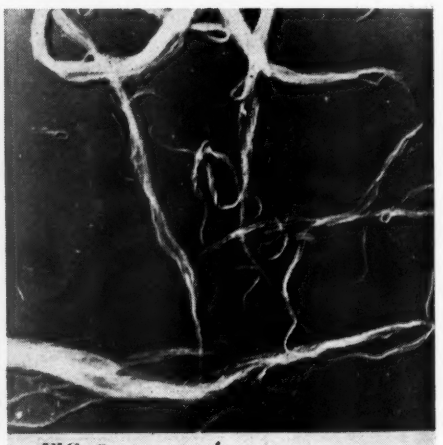

FIG. 9

FIG. 10

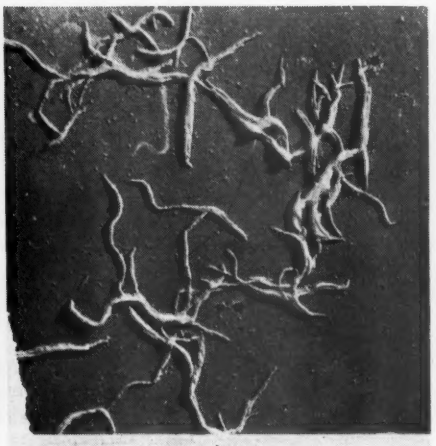

FIG. 11

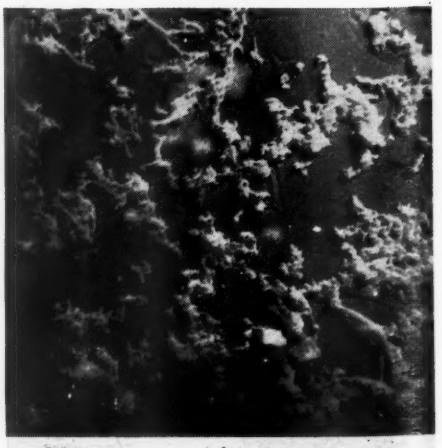

FIG. 12

of this sort in a random state would then show some crystals light while others were dark at the same time. If the crystals were all aligned in a field, then all the crystals would be light simultaneously or dark simultaneously as they are rotated in polarized light.

As soap fibers are crystals in the true sense of the word with different crystal axes, they will also react the same in polarized light. If now these fibers are randomly situated some will be dark while others are light. If they are all oriented in the same direction they will all be light simultaneously or dark simultaneously. As the whole mass of grease spread out on a slide becomes completely light or dark at once it indicates that all the soap fibers are oriented in the same direction. If the grease now is spread at some other angle to the first spread, the orientation of all the fibers then takes the direction of the new spread. The ease with which this orientation is accomplished is somewhat surprising. A single spreading stroke is sufficient to cause complete orientation.

This orientation helps to elucidate grease structure. It helps to show that the soap fibers form a structure by themselves when in grease form and that they will maintain this form when the oil is leached out.[5]

The following experiment indicates this to be true.

A sample of grease was spread onto a glass microscope slide. This sample showed strong birefringence. The grease film was immersed in a beaker of quiescent ASTM naphtha to leach out the oil without disturbing the soap film. After removal from the naphtha the dry soap film had the same birefringence as the original grease. A second sample of the grease was vigorously shaken with naphtha to disperse the fibers completely, and a few drops of this suspension were dried on a microscopic slide. This random suspension showed no oriented birefringence. This proved that the fibers in the undisturbed soap film were the same as they were in the grease and that they were oriented in both cases. The random dispersion destroyed this orientation.

Birefringence in this grease system is similar to a phenomenon in colloid systems known as "streaming double refraction" whereby particles, such as rods or fibers suspended in a liquid, will align themselves in a flowing system so that their long axis is parallel to the direction of flow.

In the grease system the same orientation effect takes place[8,10] except that it remains as a permanent effect after the orienting force is removed, whereas the colloidal system reverts to a random state when flow ceases.

A number of different greases with different fiber structures have been examined for this optical birefringence. In almost all cases greases that have well defined fibers as shown on the electron microscope gave strong oriented birefringence while greases with no apparent fibers gave little or none.

Some correlation has been noted between birefringence and colloid milling. In some cases a grease made without use of the colloid mill has not exhibited birefringence, but after treatment in the colloid mill the same grease now shows strong birefringence. This is strong proof that much fiber dispersion and orientation occurs in the colloid mill, especially since the individual fibers did not show any great change between the milled and unmilled sample as examined on the electron microscope.

The orientation of fibers previously mentioned can also be observed directly by examination on the electron microscope. A very thin film of grease spread onto a specimen mount was leached in ASTM naphtha without disturbance and shadowed. This preparation when examined on the electron microscope showed orientation of fibers in one predominant direction over the whole area of the specimen. Representative pictures of two oriented greases are as follows: (Figs. 3 and 4).

The arrangement of soap fibers in a grease and the reaction of these fibers in a moving system is thus revealed by use of both the electron microscope and optical microscope.

Composition Variables

The effect of composition of a grease on its fiber structure is one of major consideration. An important composition variable is the fat or fatty acid component. In order to study the effect of using various fatty acids a series of lithium greases was made using 12 hydroxy stearic acid, the methyl ester of 12 hydroxy stearic acid, the glyceride of 12 hydroxy stearic acid (hydrogenated castor oil) and the polymerized form of 12 hydroxy stearic acid. Greases were prepared from these four materials in the same way at 320 F maximum processing temperature with the following results. The grease from the straight acid is seen to exist in granular form with a very few primitive fibers. (Fig. 5).

The grease from the glyceride of 12 hydroxy stearic acid had short (lu) loosely twisted fibers as shown in the following picture. (Fig. 6)

The grease from the methyl ester of 12 hydroxy stearic acid also contained small loosely twisted fibers that were similar to the type found in the glyceride grease. (Fig. 7)

Finally the grease from the polymerized 12 hydroxy stearic acid contained very fine filament like fibers about lu long with a slight twist (Fig. 8)

The penetrations of these four greases with a soap content constant at 10 per cent were as follows:

Fat or Fatty Acid	U.W.Pen.	Worked Pen.(60)	Fiber Structure
Glyceride of 12 OH St. Acid	280	284	lu long 700A thick-loosely twisted
Methyl Ester 12 OH St. Acid	295	298	lu long 700A thick-loosely twisted
Polymerized 12 OH St. Acid	339	361	lu long 300A thick-moderately twisted
Free 12 OH St. Acid	403	446+	Granular particles (¼ u)

These data indicate that the larger fibers give the most rigid gel structure while the grease with granular soap particles has a very weak gelling effect at the maximum processing temperature of 320 F.

Lithium greases from oleic acid and stearic acid were also examined. The grease from oleic acid at 320 F showed very long (10 u or more) string-like fibers with no twist. (Fig. 9)

The grease made from straight stearic acid at 320 F shows small flat granular particles (ca. lu). (Fig. 10)

A grease made from tallow at 320 F shows fibers of intermediate length (ca. 3u) without any twisting characteristics. (Fig. 11)

These pictures show the wide variation of soap fiber structures obtained by the use of various fats and fatty acids in the preparation of the grease. These greases will understandably have widely different properties that may be chosen for a particular application.

Effect of Temperature

As in the case of all crystal systems the effect of temperature on particle formation in greases is very important. Fiber formation is aided by heating to a temperature near the solution point where well defined fibers are able to be formed, much as single crystals are grown in inorganic systems.

A grease was made from 12 hydroxy stearic acid at 320 F. The soap then existed as granular particles about ¼ micron in size. This grease was heated to 370, 380, 390, and 400 F. A few primitive fibers were formed at the lower temperatures but at 400 F perfectly twisted fibers of 10 u or more in length were formed. Micrographs are as shown in (Figs. 12, 13, 14, and 15)

At 400 F a pronounced gelling of the

FIG. 1. Naphtha leach.

FIG. 2. No naphtha leach.

FIG. 3. Oriented lithium grease.

FIG. 4. Oriented calcium-sodium grease.

FIG. 5. Lithium grease from straight 12 hydroxy stearic acid (320 F).

FIG. 6. Lithium grease from the glyceride of 12 hydroxy stearic acid (320 F).

FIG. 7. Lithium grease from the methyl ester of 12 hydroxy stearic acid (320 F).

FIG. 8. Lithium grease from a polymerized 12 hydroxy stearic acid (320 F).

FIG. 9. Lithium grease from oleic acid (320 F).

FIG. 10. Lithium grease from straight stearic acid (320 F).

FIG. 11. Lithium grease from beef tallow (320 F).

FIG. 12. Grease heated to 370 F.

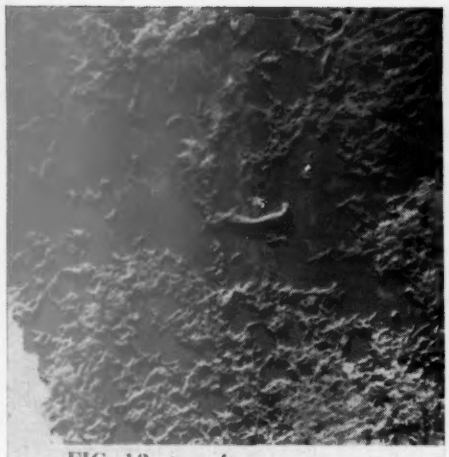

FIG. 13

FIG. 14

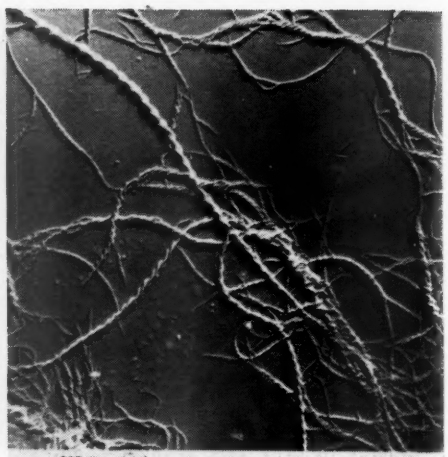

FIG. 15

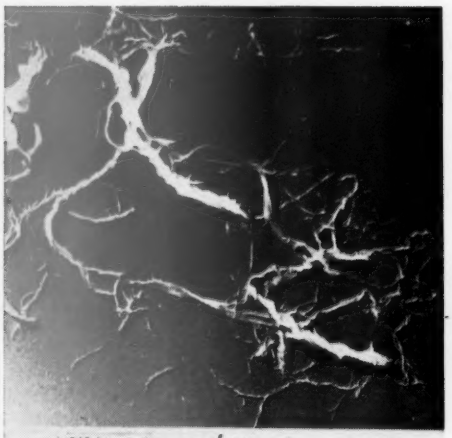

FIG. 16

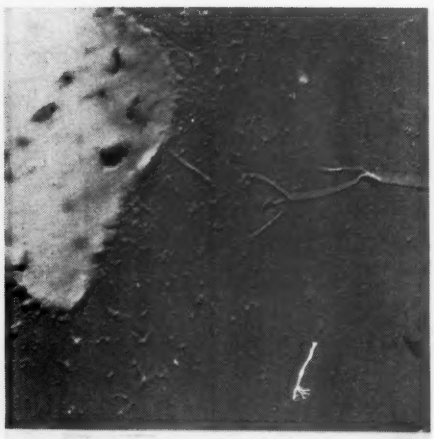

FIG. 17

FIG. 18

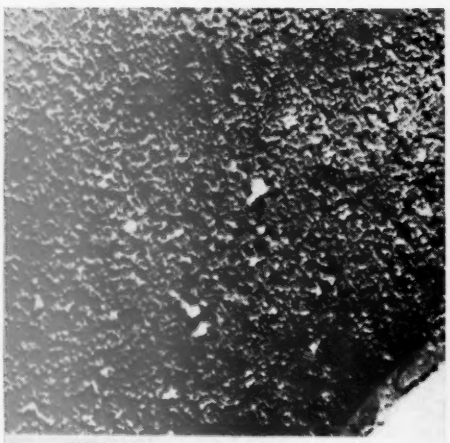

FIG. 19

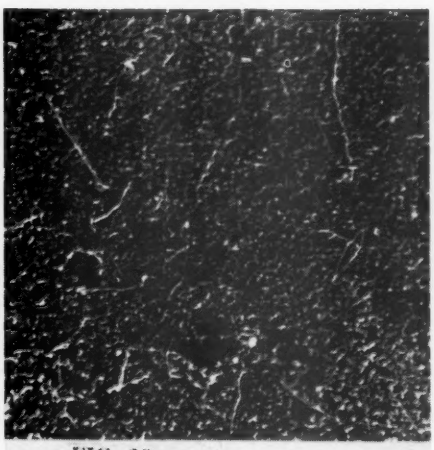

FIG. 20

FIG. 21

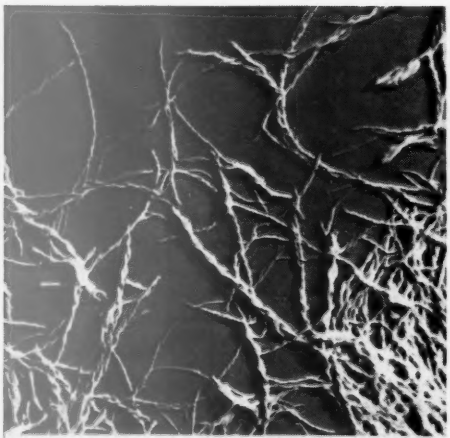

FIG. 22

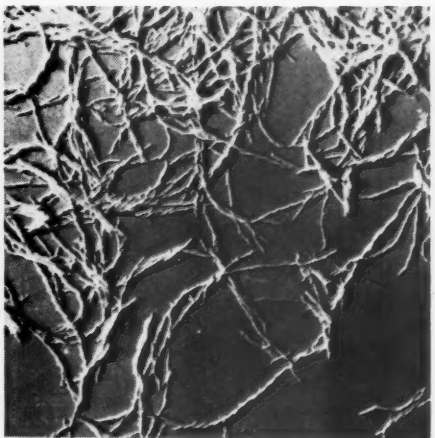

FIG. 23

FIG. 24

grease occurred in correlation with the formation of the long fibers. The grease changed from a No. 1 grade to about a No. 3 grade at this transition point.

X-ray evidence of this phase transition indicates that it occurs at a somewhat lower temperature. Perhaps the X-ray method stresses the primitive fibers formed at the lower temperature more than the granular particles.

If the grease with the symmetrical form of twisted fiber is heated to its true solution point and cooled in air to room temperature the homogeneity of the fibers as well as the twist is destroyed. (Fig. 16)

These data indicate the important changes in the soap fiber structure due to temperature variations and the accompanying change of gelling power that the formation of fibers imparts to the grease.

Effect of Oxidation

Oxidation of a grease in use has an adverse effect on its characteristics. It was desired to know if the soap structure was affected in this oxidation, as this would be of major concern. The following experiment was performed for this purpose.

A lithium grease with a well defined fiber structure as shown in Fig. 1 was oxidized in a Norma Hoffman bomb for 177 hours in presence of a copper catalyst. This grease showed no soap fibers remaining after oxidation. (Fig. 17) Some amorphous material was evident on the microscope but the fiber structure had vanished completely. The physical appearance was that of a liquid containing some black amorphous material. This shows that the soap fiber structure is adversely affected by oxidation, and illustrates the need for good inhibition of such greases. The above experiment is an example of accelerated oxidation. A study of the effect of progressive oxidation upon soap fiber structure is currently underway.

FIG. 13. Grease heated to 380 F.

FIG. 14. Grease heated to 390 F.

FIG. 15. Grease heated to 400 F.

FIG. 16. Lithium grease from 12 hydroxy stearic acid heated to 425 F.

FIG. 17. Lithium grease after 177 hr Norma Hoffman oxidation test.

FIG. 18. Virgin lithium grease.

FIG. 19. Same grease after 377 hr in wheel bearing.

FIG. 20. Lithium grease after 30 min in wheel bearing.

FIG. 21. Virgin lithium grease.

FIG. 22. One pass through colloid mill.

FIG. 23. One-hour recirculation in colloid mill.

FIG. 24. Above grease after 100,000 strokes A.S.T.M. worker.

Breakdown of Fiber Structure with Mechanical Work

One of the important aspects of grease research is a knowledge of the effect that severe mechanical working has on the grease fiber structure. If this structure is drastically changed as a grease actually lubricates the bearing surfaces, it is logical to assume that the bulk property of that portion will also be changed.

It was desired to examine a specimen of grease taken directly from the surface of a roller in a roller bearing, as this would give a good sample of grease that had actually been sheared between bearing surfaces. The method finally devised to obtain such a specimen was to take a piece of specimen screen covered with a formvar film and roll it over the surface of the roller without allowing it to contact the adjacent bulk grease. Some of the grease on the roller surface would be transferred to the formvar film. This sample could then be leached with ASTM naphtha, shadowed and viewed on the microscope.

This method was used on several greases in wheel bearing tests. In the first sample thus examined it was found after 377 hours performance in a laboratory wheel bearing that fibers that had been several microns long and twisted in the virgin grease (Fig. 18) had now degenerated into granular particles less than 700 A in size. (Fig. 19) This was a reduction of size by a factor of about 50 or so. Very few fibers remained in their original form.

It was then desired to know at what time such destruction of fibers occurred. Further experiments indicated that complete degradation of fibers on the bearing surface could take place in a wheel bearing in less than 30 min. (Fig. 20.)

The question then arose as to whether this degeneration was caused by excessive local heat or mechanical fracture. This was answered in the following way. A grease that has symmetrical twisted fibers in the virgin state shows granular particles with a few fibers after use in the bearing. The remaining few fibers still possess their characteristic twist although they are now much more thin than in the unworked state. Samples of this virgin grease that have been overheated to the solution point have lost the symmetrical twisted fibers and the fibers are now heterogeneous in size and shape. Therefore, the residual fibers in the worked specimen probably have not been overheated as they retain their characteristic shape.

Also in this respect is the consideration of the effect of temperature on the soap in granular form previously described. If a granular low temperature grease is heated above its transition temperature it becomes fibrous in nature. But in the grease worked in a roller bearing the soap exists in granular form, after having been in fibrous form in the virgin state. It is logical to assume that if these granular particles had been subjected to a higher temperature they would have been reformed into fibers of some sort. As this is not the case it is some indication that fiber destruction in this instance is not caused by excessive local temperature and would be due to mechanical fracture.

In the micrographs of some used greases, abrupt fracture edges can be seen at the fiber ends. This also is some proof that reduction of fiber length by work is a result of mechanical fracture.

Relation of Various Work Tests and Actual Bearing Use

Some attempt has been made to evaluate the intensity of work the various work tests and bearing use perform on the grease soap fibers.

A lithium grease with homogeneous symmetrical twisted fibers was used in these tests as modifications in the fibers could be easily detected, (Fig. 21). This grease was worked in the ASTM worker, the Navy worker, a colloid mill, the Shell roll tester and a wheel bearing tester with the following results:

After one pass through the colloid mill at .003-in. clearance there was no appreciable effect on the fibers, (Fig. 22). After one hour of continuous recirculation through the mill the fibers had lost much of their twist and some fiber breakdown was noted, (Fig. 23).

After 100,000 strokes in the ASTM worker with ¼-in holes the same grease as above showed that some of the fibers had lost their twist and some breakdown of fiber length was noted, (Fig. 24).

The broken fibers in this grease have very abrupt fracture edges indicating this is a mechanical fracture of fibers.

Several tests were made on the Navy worker with 1/16-in. holes at increments of 100,000 strokes. After the first 100,000 strokes the soap fibers show somewhat more change than after 100,000 strokes in the ASTM worker, (Fig. 26). The fibers have been fractured more severely than in the ASTM worker after 100,000 strokes, with some small particles being formed (ca. 2000 A). Many of the fibers have become thinner than normal and the whole soap structure is now more heterogeneous than normal in size and shape.

The same grease was examined after each additional 100,000 strokes. A progressive deterioration was noticed in that the number of small particles increased, the fibers lost much of their twist and the fiber structure in general became more heterogeneous, (Figs. 27 and 28).

Experiments were also run on the Shell roll tester using the same virgin grease as used in the ASTM and Navy worker tests. In one test the normal amount (70 grams) of grease was used. After 48 hours in the tester the fibers had been broken down to less than half their normal length. Some small particles had been formed but most of the fibers were homogeneous as to length, (Fig. 29).

In another test on the Shell roll tester a very small amount of grease was used. This amount was just sufficient to cover the roller with a thin film of grease. After 79 hours in the tester the fibers

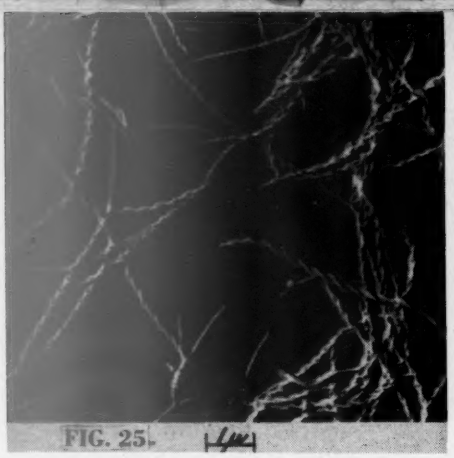

FIG. 25.

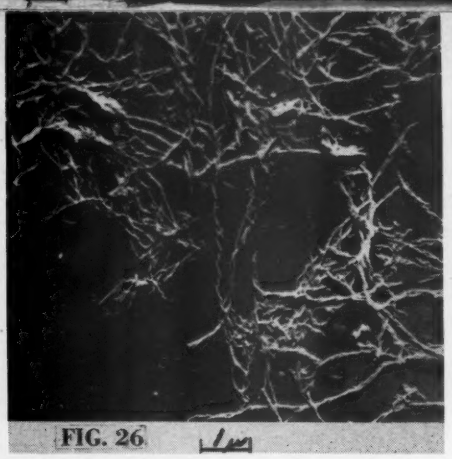

FIG. 26.

FIG. 27.

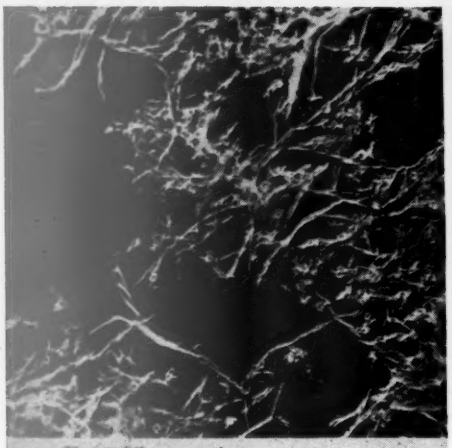

FIG. 28.

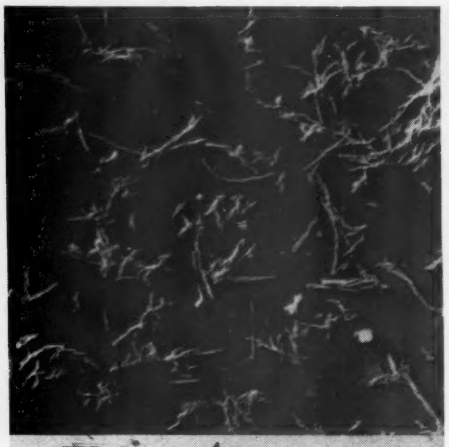

FIG. 29.

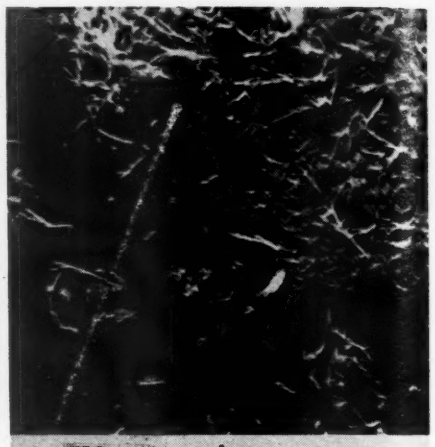

FIG. 30.

FIG. 25. Virgin grease.

FIG. 26. After 100,000 strokes in navy worker.

FIG. 27. After 300,000 strokes in navy worker.

FIG. 28. After 500,000 strokes in navy workers.

FIG. 29. Lithium grease after 48 hr in Shell roll tester. Normal amount of grease used.

FIG. 30. Lithium grease after 79 hr in Shell roll tester. Very small amount of grease used.

had been broken down severely, (Fig. 30). Many small particles were formed and the remaining fibers were less than half their normal size. The soap particles in this test were more heteregeneous in size and had lost more of their twist than those in the first test, where more grease was used.

These results indicate the relative severity of the various work tests. None of these tests, however, can match the destructive effect on the fibers which is found in actual roller bearings.

The important information derived from these experiments is that the mechanical work performed by the ASTM worker and Navy worker, etc., does not effect the fiber structure nearly as much as actual service conditions. Even 500,000 strokes in the Navy worker with 1/16 in. holes does not have the destructive effect of the wheel bearing.

Summary

Use of the electron microscope as a tool in grease research has revealed the following interesting information about lithium greases:

1. Indicates, in conjunction with optical microscope examination, how greases with well-defined fibers will orient their fibers in the bulk grease in a moving system.

2. The formation of long fibers in certain lithium greases when heated to the transition temperature is accompanied by pronounced gelling effect.

3. There are wide variations in the fiber structure of lithium greases depending on their composition. There appears to be some correlation between fiber structure as revealed by the electron microscope and physical and performance properties.

4. Certain lithium greases with well-defined fiber structures have very good mechanical stability as determined by long time tests in several types of laboratory working devices. Some of these greases when run in a wheel bearing can have their fiber structure completely destroyed in a very short period of residence on the actual bearing surfaces, which is accompanied by softening of this portion of the grease. If the fiber structure of the grease is such that the bulk of the grease is drawn through the bearing surfaces, softening of all of the grease in the bearing assembly can occur to a much greater extent than would be predicted by laboratory worker tests.

The information gained thus far in this preliminary investigation of greases by the electron microscope has given an insight into the true structure of greases. This knowledge is of great value in the formulation of new and better greases, and the electron microscope has thus established itself in our laboratories as an important tool in grease research.

Acknowledgment

The authors wish to extend their thankful appreciation to M. M. McCormick and H. D. Gower for the preparation of the experimental greases; to R. A. Van Nordstrand for the X-ray diffraction work; and to R. H. Gardner, M. Fairlie, and J. W. Teter for their very welcome encouragement and direction during the course of this work.

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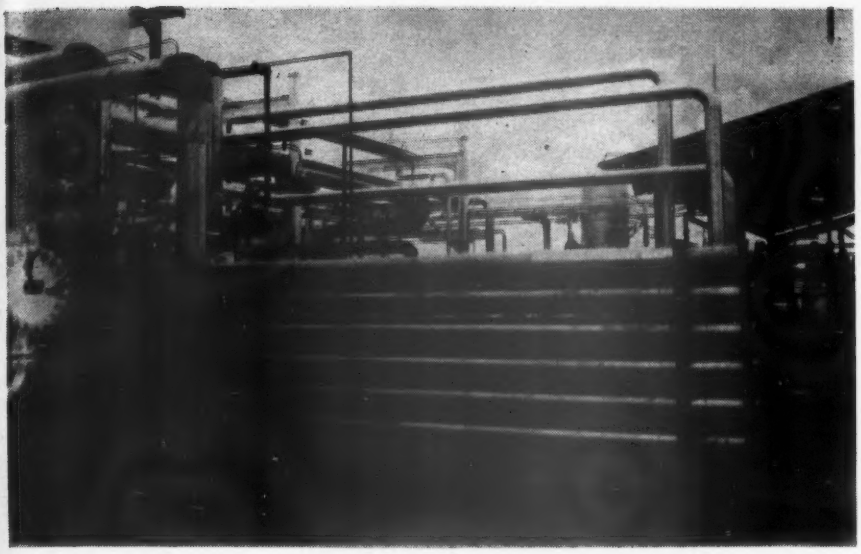


FIG. 1. Reformer charge preheater exchangers of G-R G-Fin design, installed in Premier Petroleum Company's new Platformer unit at Fort Worth; the raw topped charge is joined by the compressed hydrogen-bearing gases just prior to entering these exchangers.

EXCLUSIVE

ARCH L. FOSTER*

New Platformer Improves Octane Rating

MODERN CATALYTIC REFORMER RAISES OCTANE NUMBER IN LINE WITH COMPETITIVE LEVELS

DURING the postwar period practically every refiner faced the same dilemma—the problem of how to meet the challenge of competitors on motor fuel quality, especially for octane ratings. Such a problem was faced by Premier Petroleum Company, operating refineries at Fort Worth, Longview, Baird, and Arp, Texas. The plant at Fort Worth operates on Ranger crude, a relatively clean, low-sulfur crude with some advantages as a charge stock. Octane ratings are not too attractive, however, on straight run gasoline especially, and total, overall motor fuel yield could be improved to advantage.

In consequence of the problem and meticulous study of the possible solutions, company management decided on the installation of the catalytic reforming system called the Platforming Process licensed by the Universal Oil Products Company. A 1500 bbl per day unit was designed and installed, and the unit was placed in operation in July, 1951.

Briefly, the unit includes a prefractionator column with preheat exchangers; Platformer charge exchangers (G-R G-Fin, see Fig. 1); three Petrochem type furnaces; stabilizer column; three reactors; reactor product separator and compressor suction drum; two hydrogen gas compressors, and the necessary control and recording instruments, transfer pumps, rundown tanks, etc. The prefractionation column is actually a raw distillate splitter, available in the refinery and utilized essentially "as is". The charge pump to the reactors, a National Transit also available in the refinery, is driven by an Elliott steam turbine, and handles the entire charge to the reactors from the column.

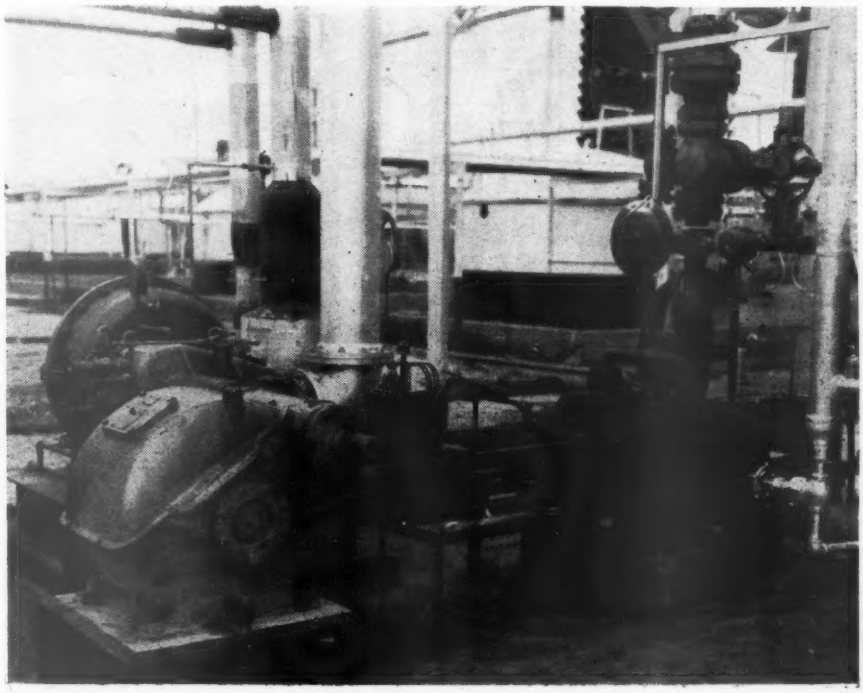


FIG. 2. National Transit naphtha charge pump (right foreground) and Elliott steam turbine driving the pump (left background).

* Editor, Refining and Gas Processing.

Prefractionator Column

The three Petrochem heaters, each designed for different capacities as indicated by their relative sizes, and shown in back of the reactors, (Fig. 3) are all equipped with alloy tubes and return bends and are fired with refinery waste gas. The largest furnace, left in the figure, has two coils in parallel; the second and third furnaces have two coils also. The reactors are carbon steel with no alloy. These reactors are heavy wall vessels, no heat being transmitted through the walls to the reactor charge or catalyst inside. The three reactors are charged with the platinum containing catalyst.

All piping which comes into contact with hydrogen, and all other metal in the hydrogen-containing part of the cycle is made up of alloy steel. All instrument tubing is copper, it being considered the easiest to handle and the most workable of the metals available in this small tubing.

The control and recording instruments employed are largely Foxboro, these constituting about 85 per cent of the total instrumentation. Some L&N controllers are used in all 13 main instruments and 10 dial indicators are used on the main control room panels, which were built and erected by company personnel.

The hydrogen compressors are I-R 165 hp twin-cylinder units, set nearby the suction drum built direct-connected to the reactor product separator, both shown in Fig. 4. The various Byron-Jackson reflux pumps are gathered together in one battery as shown in Fig. 6, and are powered by GE motors.

Safety Valves

For safety precautions seven safety valves are installed in various points in the unit: Prefractionator vapor line, stabilizer overhead receiver, reactor charge pump discharge, combined feed to heat exchanger, products separator, and discharge of each recycle gas compressor.

Steam hoses are installed at different points as fire fighting equipment, also chemical and CO_2 extinguishers are placed at strategic points. In each furnace a steam snuffing line is installed as permanent equipment. All fittings are backwelded. On drawoff lines two valves are installed instead of the conventional single valve, and numerous other precautions are taken to prevent fire outbreak or to extinguish a fire if it starts.

Operation of Unit

As stated above the refinery operates on Ranger crude. Raw gasoline of about 55 API gravity and 88 to 400 F boiling range is heated by preheat exchangers to 210-220 F and flashed in the prefractionation tower; overhead of this tower is taken a light straightrun fraction which is blended into the plant's gasoline product; this cut constitutes some 15 per cent of the total raw gasoline charged to the stabilizer. The remainder of the raw naphtha, with a boiling range of about 200-400 F is joined by compressed hydrogen of the order of 750-800 psig and passes to heat exchange with the stream from the last reactor enroute to the reaction product condenser, and is heated to about 500 F. As mentioned earlier, the metal in contact with hydrogen at elevated temperatures is alloy. The preheated hydrogen naphtha mixture is heated further in the first and largest Petrochem heater to 900-920 F, and discharged into the first reactor, into contact with catalyst in the form of pellets. The partially reacted charge leaves the first reactor at a reduced temperature and is reheated to the 900-920 F range in the second heater and reacted further in the second reactor. A third time it is reheated to the optimum reaction temperature and it then passes through the largest reactor, which because of the greater space and catalyst content gives the longest time of contact in order to insure that the maximum amount of the charge is reacted before passing entirely from the reaction system.

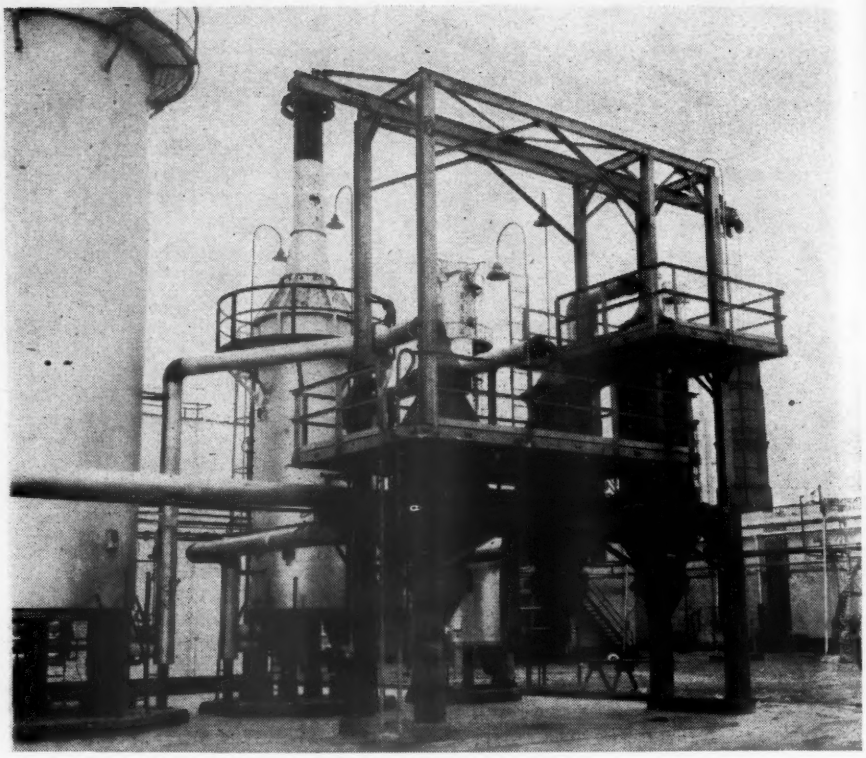
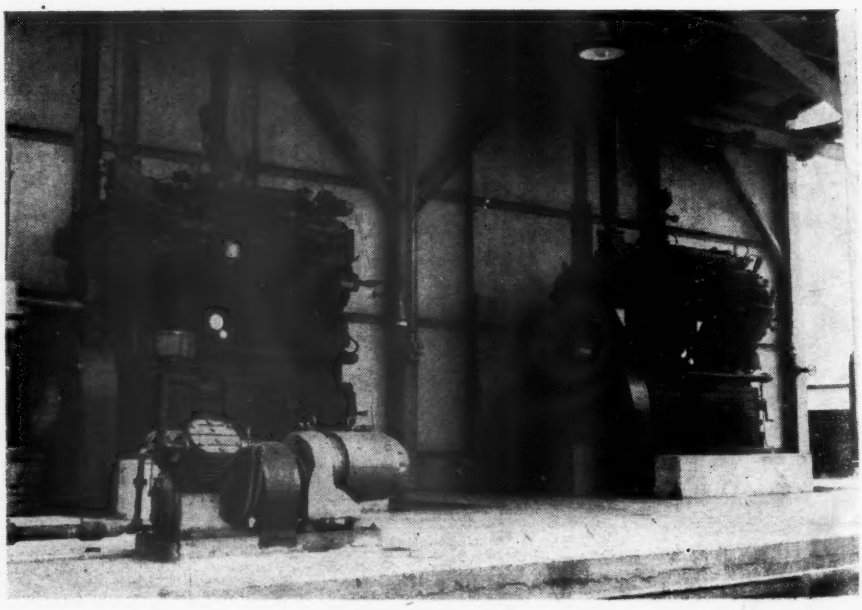
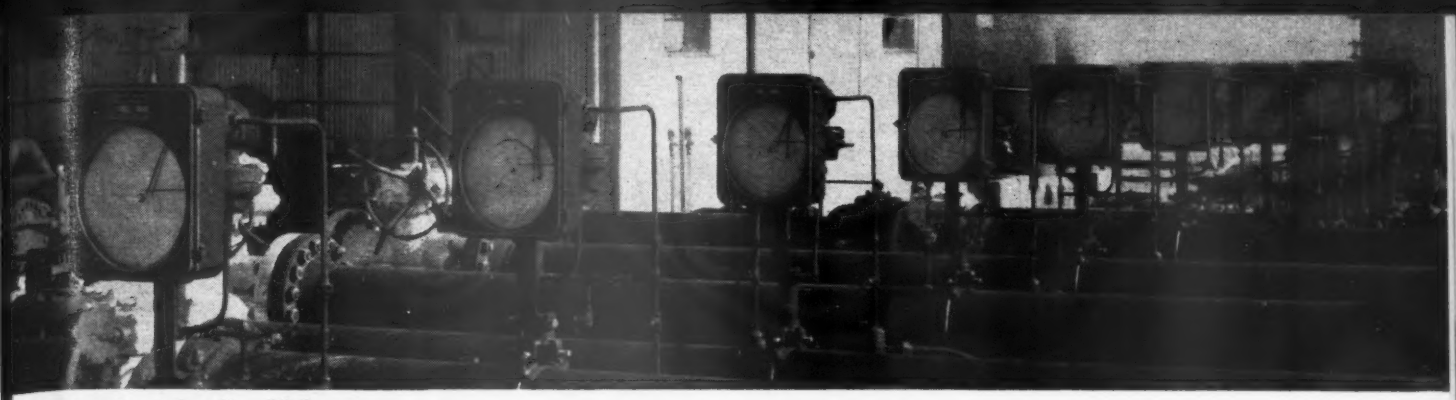


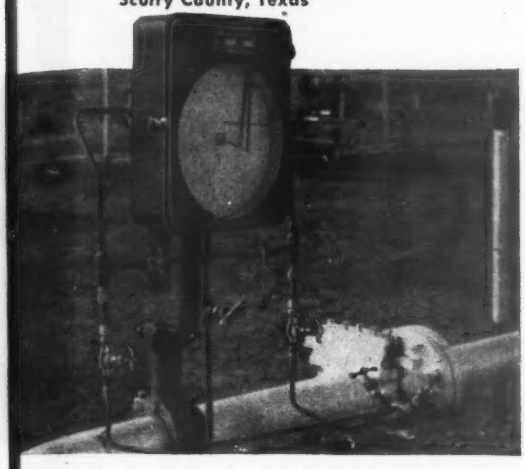
FIG. 3. Three carbon-steel reactors, A. O. Smith-designed and built, which contain a total of about three tons of platinum-containing catalyst. Note the large size of the third reactor at right, holding as much catalyst as both the other two reactors.

FIG. 4. Two 165-hp Ingersoll-Rand hydrogen compressors.

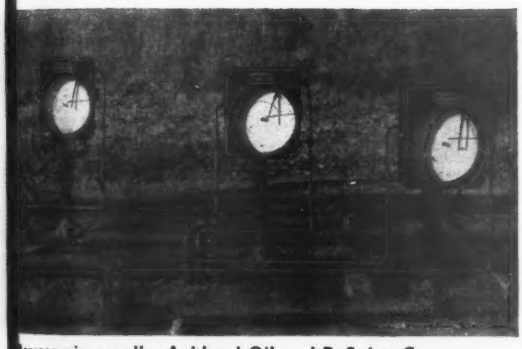




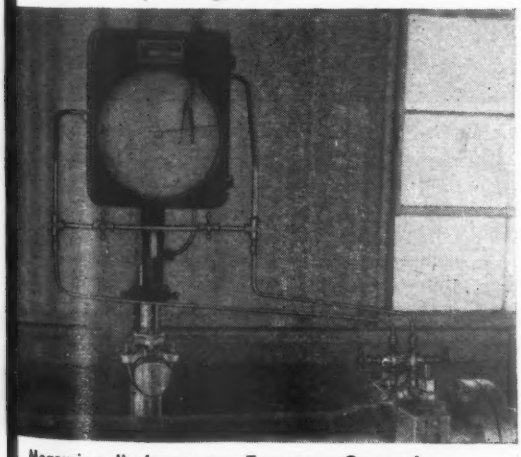
Gas booster station, Lion Oil Company, Scurry County, Texas



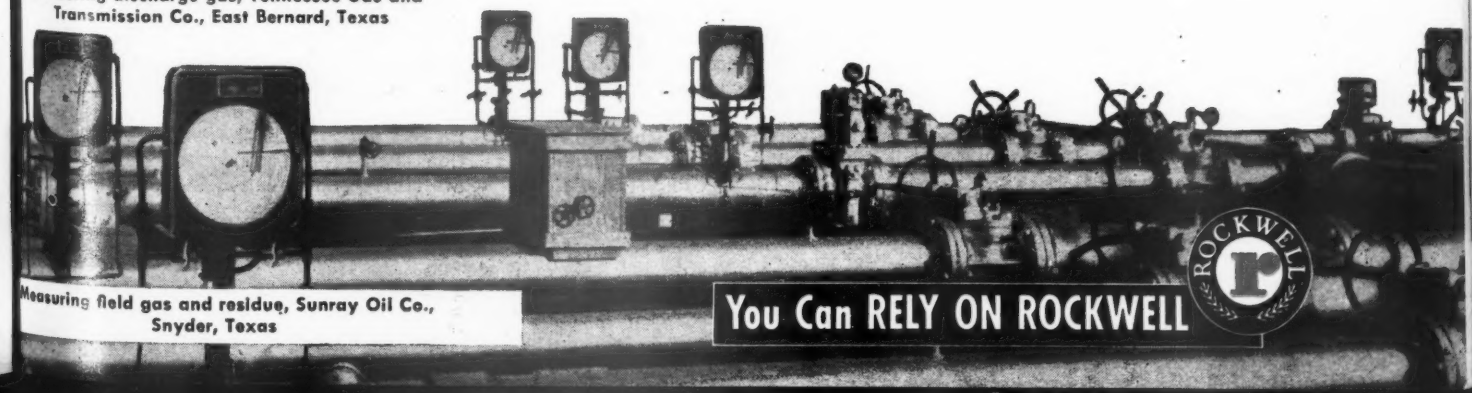
Wilshire Oil Company, Snyder, Texas



Repressuring wells, Ashland Oil and Refining Co., Spaulding, Okla.



Measuring discharge gas, Tennessee Gas and Transmission Co., East Bernard, Texas



Measuring field gas and residue, Sunray Oil Co., Snyder, Texas

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Three Reactor System

The three-times reacted charge is sent finally to a cooler and then to the product separator tank, Fig. 5, which is the horizontal drum in that view. Unreacted hydrogen is withdrawn by the hydrogen compressors which take suction on the vertical separator drum and is compressed to the 750-800 psig range mentioned above for recycle to the reactors. The separated liquid containing some C_4's is sent to the plant stabilizer where it is stabilized at a reboiler temperature of about 450 F. Practically all the propane is taken off either in the hydrogen stream to the compressors or overhead from the stabilizer along with any excess C_4's present in the reaction product, to plant fuel.

Platinum Catalyst

The stabilized product passes to storage essentially sulfur-free, and with a boiling range of about 100-400 F. In this operation no bottoms are obtained. no "heavy ends" and no recycle. Except for light overhead taken off by the final stabilizer the entire charge becomes motor fuel component, its boiling range and hydrocarbon composition being the two major properties changed by the reforming reaction. Platinum, either in the form of colloidal platinum, "platinum black" or in other metallic or chemically combined forms, has been employed for many years as a hydrogenation catalyst and although the metal is expensive per unit of first cost its catalyst life is long. In this plant a minimum total yield of reformed gasoline of 32 bbl per lb of catalyst is expected. In another plant which has been in operation for about two years, the catalyst life has far exceeded this figure.

The composition of the finished reformed naphtha is determined to some extent by the nature and properties of the charge stock treated. Composition is affected further by the operating conditions. Normally above one-third of the product is aromatic in structure although the exact figure may vary over wide limits, depending on the type of product required by the operator. The process is one of the more important means for obtaining benzene, toluene and other aromatics in large quantities from petroleum sources. Typical distillations of raw naphtha, of depentanized naphtha as charged to the reactors and of the finished, stabilized reformed product are shown in Table 1.

TABLE 1. Typical inspections of platformer streams.

	Raw naphtha charge to prefractionator	Depentanized naphtha to reactors	Stabilized platformate
API gravity	58.9	55.8	58.5
Engler distillation			
IBP	114	174	93
10%	177	209	130
50%	262	268	220
EP	395	396	395
RVP	4.7	1.3	9.4
Octane numbers			
F-1 clear	51.7	49.5	83.4
F-1 3 cc TEL	—	70.0	95.0
F-2 clear	—	45.3	77.5
F-2 3 cc TEL	—	68.2	88.6
Total Sulfur	ASTM 0.04	ASTM 0.03	Turb. 0.0017
H_2S (Wt. %)		Nil	Nil
RSH as S (Wt. %)		0.0036	Nil
ASTM Gum (mg/100ml)			0.5

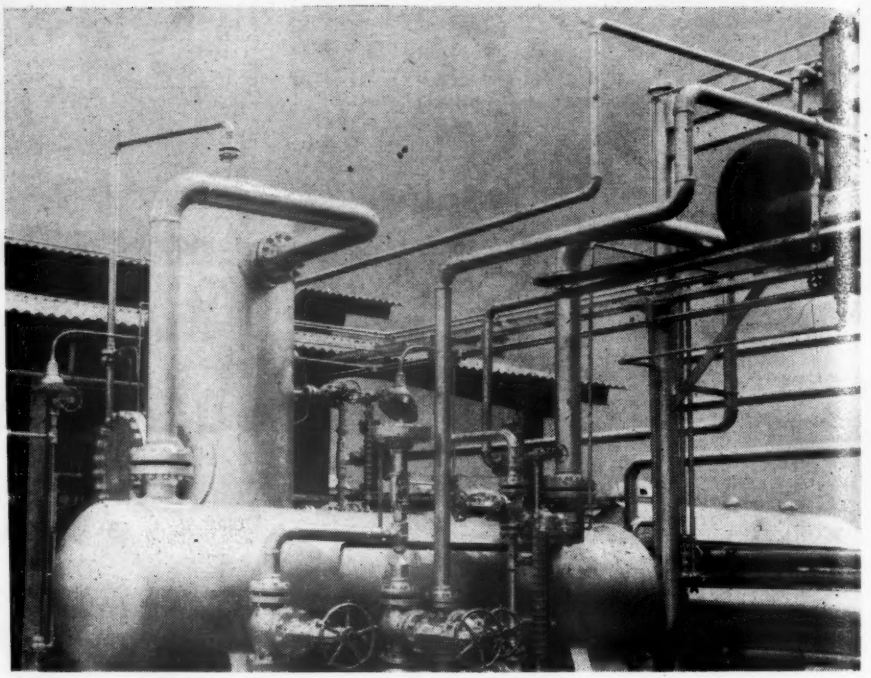


FIG. 5. Reactor product condensate (rundown) tank, horizontal, and hydrogen gas suction drum, vertical, on which last the compressors take suction to recycle hydrogen-rich gas to the reactors. Valves are heavy Vogt-built.

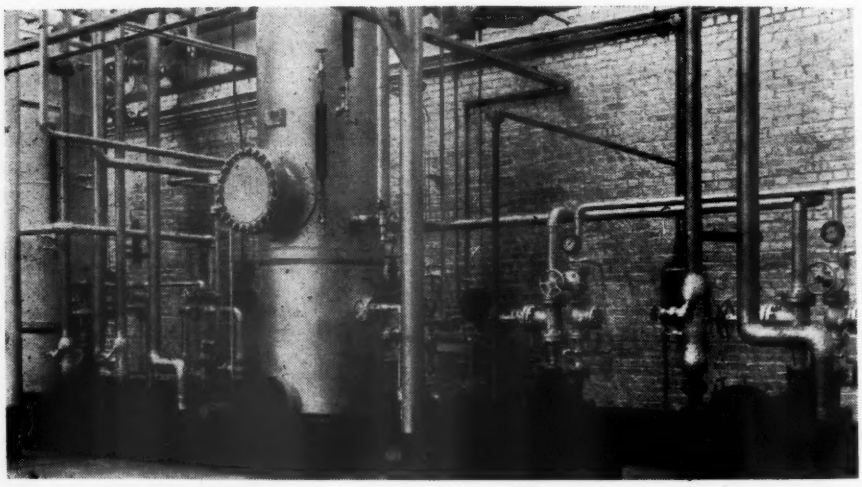
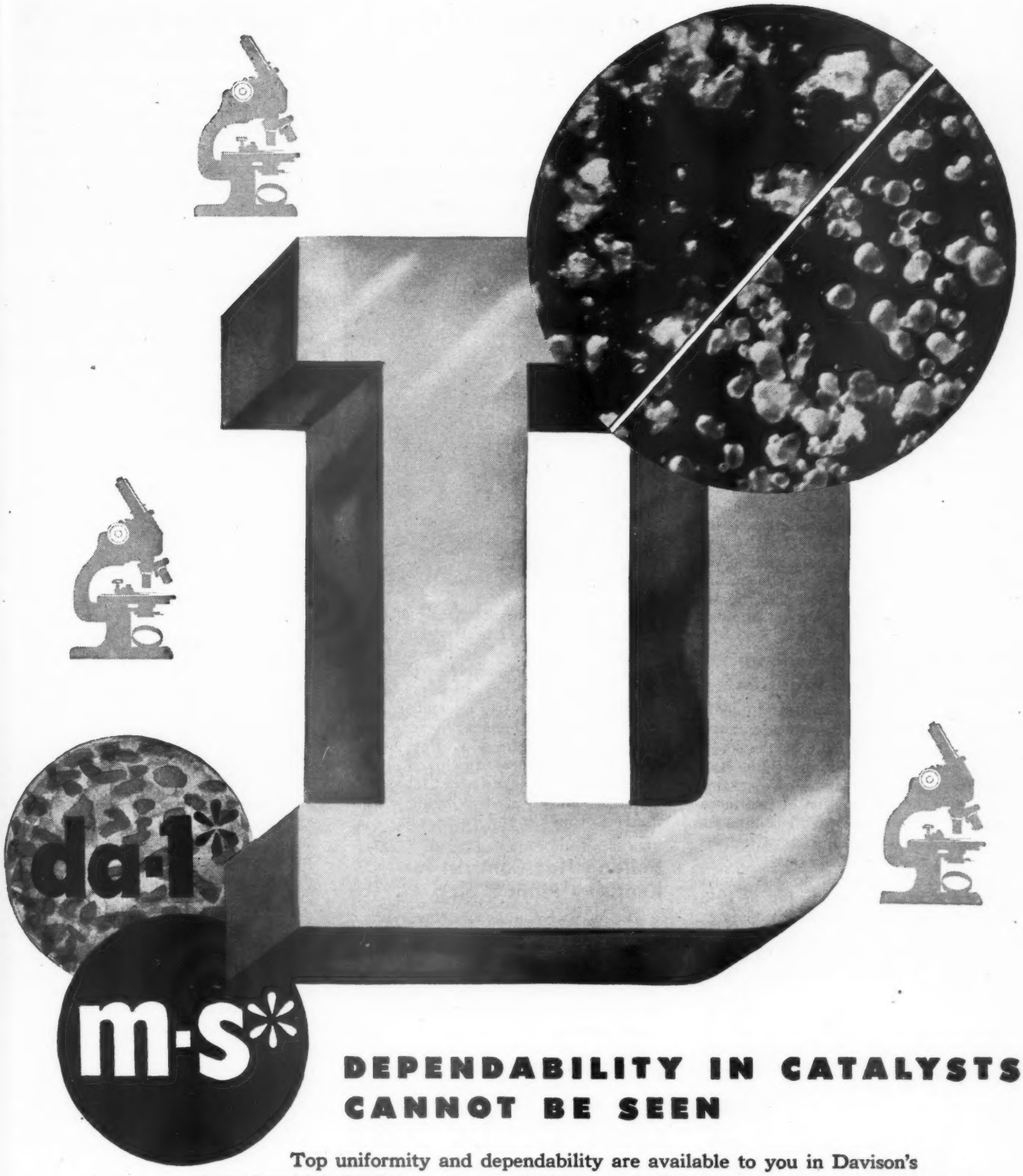


FIG. 6. General Electric motor-powered Byron-Jackson reflux pumps for this unit, grouped in a single battery.

95 Per Cent Yield

Yields obtained may vary, also, between about 90 per cent to 95 per cent of the charge to the reactors, depending on the octane ratings desired and obtained. The octane ratings produced may be varied between rather wide limits by proper control of the reforming conditions such as temperature, pressure, hydrogen-naphtha ratio, space velocity through the reactors, that is, contact time with the catalyst, age of catalyst, and various other factors within control of operator. Obviously, too, octane ratings and yields are dependent somewhat on the hydrocarbon composition of the charge stock. The normal octane ratings obtained from this unit range from 92 to 96 leaded Research rating.

The plant discussed here installed a large number of pieces of used equipment available in the refinery, such as the stabilizer or naphtha splitter tower, pumps, instruments, etc. and thus reduced importantly the net cash-out-of-pocket cost of this unit. Estimates show that the total cost of an entirely new 1500 bbl of charge per day unit may range from $750,000 to $900,000, variations being due largely to equipment availability, local labor and other conditions, cost of site preparation and similar factors. * * *



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NEWS

Continental to Expand Its Ponca City Refinery

Continental Oil Company will spend approximately $7,500,000 on an expansion program in its Ponca City, Oklahoma, refinery, largest of the company's eight plants, L. F. McCollum, president, announced.

Construction of the new facilities, which will include advanced design refining equipment, a lubricating oil additives plant, and electric power plant equipment, will begin in the late spring, and will require about 18 months for completion.

Major project in the Ponca City refinery expansion will be the installation of new coking equipment of the continuous contact type at a cost of approximately $3,550,000. This process will make it possible to produce overall gasoline of substantially higher octane rating.

Also scheduled for installation at the Continental plant is an electric turbine generator, a high-pressure steam boiler, and auxiliary equipment for the power plant. Another $2,000,000 will be invested in a lubricating additives plant.

NGAA Expands Fractional Analysis Research Program

Furthering its efforts to eliminate human errors in low temperature analysis of hydrocarbon mixtures, the Fractional Analysis Committee of the Natural Gasoline Association of America has begun the distribution of two more liquid samples to the 61 oil companies and commercial laboratories participating in the research program.

The new samples will be Nos. 4 and 5 in the series that was begun in 1948 and reported in the NGAA Proceedings in 1950. They will be blended by the Special Products Department, Phillips Petroleum Company but their exact composition will be unknown to any of the laboratories. All laboratories will report their analytical results to the NGAA secretary who will identify them only by code number previous to correlation of the data. Members of the correlating group are: A. J. Miller, Phillips Petroleum, chairman of the Analysis Committee; Joe F. Wood, Skelly Oil, chairman of the NGAA Technical Committee; M. F. Wirges, Cities Service, and G. T. Hamblen, Continental Oil.

Mexico to Modernize Two Oil Refineries

Petroleos Mexicanos, Mexican oil company, has announced it will modernize its refineries at Tampico and Minatitlan. The company reported it would spend 25,000,000 pesos ($2,900,000) on the refineries next year. Plants to take sulfur from the oil will be installed at each refinery, giving a new supply to the scarce product and at the same time improving the oil.

Test Car Handles 10 Fuels

A "98" Oldsmobile is one of the test cars employed by duPont's petroleum chemicals division in testing motor fuels "on the road". It is equipped with 10 separate fuel tanks in the baggage compartment, as shown, and the engine fuel

system may be switched to any of these, containing any fuel to be tested, at a moment's notice by the operator, operating an electric switch on the dash. It is shown here as it appeared at Austin, Texas, in early December, 1951, at an American Chemical Society meeting, accompanied by A. D. Puckett, duPont Laboratory coordinator, J. N. C. Cameron, Gulf Coast district laboratory manager, and W. W. Wingate of duPont's Corpus Christi, Texas, office.

Kellogg Has Contract for Kentucky Plant Piping

The M. W. Kellogg Company, refinery engineers and metal fabricators of New York City, has been awarded a $75,000,000 contract for the field-fabrication and erection of the process and auxiliary piping and related equipment in the two major gaseous diffusion units now well underway at Paducah, Kentucky.

The processing sections of the plant are considered the ultimate in complexity and are designed for resistance to corrosion as well as low temperature operation. These Paducah plants are very similar to the K-25 installation at Oak Ridge, which Kellogg through The Kellex Corporation engineered during World War II. They separate the fissionable isotope, U-235, from uranium hexafluoride, a gasified compound including both the normal uranium and its "explosive" isotope.

To meet the emergency completion schedule, Kellogg is training welders in a special school set up at Paducah. When completed, the entire project will take up about 7500 acres, of which about 20 per cent will be deeded to Tennessee Valley Authority for an $88,000,000 steam power plant some five miles from the plant.

Socony Plans to Build Three Thermofor Reformers

Announcement of a program of catalytic reforming capacity expansion is made by Clark Teitsworth, manufacturing director for Socony-Vacuum Oil Company, Inc., which includes three reforming units and a catalyst manufacturing plant. These units will be designed on the previously announced Thermofor Catalytic Reforming process, developed in Socony's Paulsboro, New Jersey, laboratories.

A unit will be built at each of the refineries at Beaumont, Texas, (Magnolia), Augusta, Kansas, (White Eagle), and Torrance, California, (General), and their total charge capacity adds to 37,000 bbl per day. The catalyst manufacturing unit will be built at Paulsboro, and presumably will have enough capacity to supply these three and any other units likely to be built in the near future. These units will upgrade low octane number naphthas to a quality that, with the addition of three cubic centimeters of tetraethyllead (maximum permissible in motor fuels), the Research octane rating of the product will equal 100 or higher, Teitsworth said.

The upgraded product will contain considerable quantities of aromatics of the benzene-toluene and heavier boiling range, constituents that make the fuel useful in aviation fuel blending, as well as in maintaining and improving motor gasoline quality.

In the design of these units several of the principles employed in the Thermofor Catalytic Cracking process are used, including continuous circulation of catalyst, and continuous regeneration of the spent catalyst. Bead type catalyst is to be manufactured and employed in the process, and it is assumed from the announcement that the reaction zone consists of the now well-known moving-bed design used in TCC units. Apparently, also, the thermofor type of kiln is used for regenerating catalyst by burning off deposited carbon, though specific mention of this has not been made. Among other items the catalyst acts as a desulfurizer, converting organic sulfur in the charge into compounds that make the sulfur easily recoverable, presumably as hydrogen sulfide and/or analogous compounds.

The Thermofor Catalytic Reforming Process (TCR) will be made available under license arrangements to the oil refining industry, it is announced. Final action on building these three units and catalyst plant hinges on the customary Government clearance permits.

Tokyo Office Set Up

R. S. Aries and Associates, consulting engineers and economists, New York City, have announced the opening of a branch office in Japan. H. F. Alber, chemical engineer, consultant to the Japanese Government, and formerly with the American Occupation Forces, has been named to head the office at 19 Shin-Sakurada-Cho, Shiba Minato-Ku, Tokyo, Japan.

Negligible Octane Number Increases in January Gasolines

Small, fractional research octane number increases are shown for the majority of motor fuel samples, both regular and premium grades, by the results of the January, 1952 gasoline survey conducted by E. I. du Pont de Nemours Company. If any difference, a hasty glance indicates slightly greater increases in premium than in regular grades tested. Contrariwise, the TEL content on the whole shows a lower average value, though again the difference in most cases is small, when compared with the July and October 1951 survey figures.

Typical differences in TEL content for the three surveys (July, October, January), are, for example, (cc) 1.67, 1.71, 1.57, (Charlotte, North Carolina); 1.17, 1.18, 1.19 (Cleveland, Ohio); 1.58, 1.74, 1.25, (Milwaukee, Wisconsin); all these in regular grade fuels. Analogous values for premium grades show (cc.) 1.91, 1.62, 1.52, (Chicago); 1.38, 1.53, 1.30, (Kansas City) and 1.70, 1.38, 0.83, (Salt Lake City).

Research octane ratings range in regular grade from a low of 77.7 (El Paso), to 86.9 (Boston). For premium grade the range is from 85.6 (El Paso) to 92.6 (Baltimore). El Paso uses 1.44 cc. TEL, above the average for regular, and equals the consumption of TEL in Calgary, 2.65 and 2.66 cc. respectively. Five Canadian areas show 83.2 regular average, but 88.3 for premium, well below the grand average. As no values are weighted averages, as it is understood, but are arithmetical averages of test values of one or more samples in the same area, no estimate can be made of either the total amount of TEL used, or of the overall national weighted average octane ratings.

Average octane ratings January, 1952

	Regular		Premium	
	Research Octane No.	cc. TEL per gal	Research Octane No.	cc. TEL per gal
Aberdeen, S.D.	81.8	1.25	88.5	2.16
Amarillo	80.4	1.58	88.0	2.06
Atlanta	84.7	1.19	91.3	1.37
Bakersfield	80.4	1.14	89.6	2.30
Baltimore	86.3	1.21	92.6	1.50
Boston	86.9	1.27	92.2	1.38
Calgary	79.3	1.66	85.9	2.66
Casper	81.0	0.72	89.0	1.13
Charlotte	85.3	1.57	91.5	1.68
Chicago	82.0	1.45	89.3	1.52
Cincinnati	86.0	1.62	91.1	2.04
Cleveland	86.4	1.19	91.0	1.90
Columbus	86.4	1.39	91.5	1.98
Corpus Christi	83.2	1.62	90.6	1.61
Dallas—Fort Worth	83.9	1.67	91.6	2.16
Denver	81.0	1.11	88.3	1.24
Detroit	85.6	0.97	90.7	1.86
El Paso	77.7	1.44	85.6	2.65
Great Falls—Billings	82.0	1.28	90.0	1.68
Houston	84.4	1.87	91.6	1.94
Indianapolis	83.3	1.24	89.5	1.73
Jacksonville	85.4	1.55	91.4	1.41
Kansas City	82.3	1.05	89.0	1.30
Little Rock	83.4	1.85	90.4	1.93
Los Angeles	82.0	1.43	90.1	1.90
Louisville	84.1	2.16	90.4	2.02
Memphis	83.9	1.43	90.9	1.66
Milwaukee	82.9	1.25	89.6	1.70
Minneapolis	82.3	1.56	88.6	1.94
Montreal	84.7	1.20	89.9	1.50
Nashville	83.8	1.32	90.7	1.40
New Orleans	83.8	1.67	90.2	1.78
New York	86.4	1.21	92.2	1.62
Omaha	81.8	0.94	88.7	1.42
Philadelphia	86.5	1.37	91.8	1.36
Pittsburgh	86.2	1.71	92.0	1.82
St. Louis	82.4	1.19	89.0	1.51
Salt Lake City	79.7	0.55	88.9	0.83
San Francisco	81.8	0.87	90.4	1.91
Seattle	80.7	0.98	90.1	1.57
Shreveport	83.8	1.62	90.3	2.09
Spokane	81.6	1.02	89.2	1.40
Toronto	85.4	1.27	90.1	1.64
Tulsa	82.3	1.46	89.2	2.08
Vancouver	83.6	2.29	88.7	2.45
Wichita	80.8	1.81	87.2	2.44
Winnipeg	82.8	0.76	87.1	1.20
National	83.2	1.36	90.0	1.75

Important Announcement Coming in March

In line with our policy of bringing new features to readers of Refining and Gas Processing, THE PETROLEUM ENGINEER will announce in next month's issue a new service to the subscribers and readers of this edition. This new service will be of importance to a great number of readers, among the first of its kind in oil industry publishing. It will be comparable in extent and in interest to the other feature services that we present to our readers and will be a continually renewed source of first-hand data and original information for a large proportion of the technical division of the refining and gas processing industries.

—The Editor.

Cabot Carbon of Canada Builds Carbon Black Plant

To meet the mounting demand of Canada's rubber industry for carbon-black, Cabot Carbon of Canada Limited, affiliate of Godfrey L. Cabot, Inc., of Boston, and of the Cabot Engineering Company of Pampa, Texas, has begun construction on a 15-acre site at Sarnia, Ontario, (near Polymer Corporation's synthetic rubber plant), of a 20,000,000 lb capacity oil furnace carbon-black producer of ultra-modern design. Heavy residual oils, delivered from Fluid catalytic crackers at Sarnia and tar will form basic components of the latest Canadian petro-chemical operation.

Upon completion, as early in 1952 as Government priorities will permit, the plant is expected to begin saving the U. S. about $2,000,000 hitherto required for carbon-black imports from this country. Endorsement of the project by interested Government departments has been predicated upon its significant defense contribution as well as upon its advancement of the national economy.

Sarnia Plant Designed by Texas Engineer Unit

Contract for construction of the plant, designed by the Pampa, Texas, affiliate, has been awarded to Stone and Webster Limited Canada.

Carbon-black is an essential component of most rubber products and figures prominently in the production of such strategic materials as military vehicle and aircraft tires, tubes, and other rubber parts, as well as for civilian truck, bus and passenger-car tires, and rubber goods of all kinds. Synthetic rubber is particularly dependent upon carbon-black and optimum wearing qualities are obtained by the use of the oil types of furnace-black such as are to be manufactured by Cabot Carbon of Canada Limited.

The technology of operating a carbon-black plant on liquid hydro-carbon raw materials instead of the traditional natural gas has been thoroughly tested and proved in plants situated in the United States. A singularly successful operation was begun by Cabot Carbon Limited, at Stanlow, Ellesmere Port, England, in 1950, which is currently supplying United Kingdom rubber manufacturers with essential qualities of carbon-black at significant dollar savings to the British economy.

Basic Output HAF High Abrasion Furnace-Blacks

The Canadian enterprise will produce primarily HAF high abrasion furnace-blacks, as widely used throughout the Dominion. Installations and equipment will provide also for the processing of FEF fast extruding furnace-blacks and other types as needed by the country's rubber industry. Raw material for production initially will come from refineries in the United States until the rapidly expanding refinery production in and about Sarnia, the terminus of the Interprovincial Pipe-Line overland-and-lake-tanker movement of oil from the Alberta fields, is enabled to supply the quality and type of highly aromatic liquid hydro-carbons required.

An outstanding feature of the Cabot installations is the complete smoke-elimination system, which utilizes special bag filters employing a new synthetic fibres resistant to high temperature and operative without exhaust delivery of black or smoke to the atmosphere.

Underwriting by Cabot Boston House

Underwriting of the plant has been accomplished wholly by the Boston Cabot organization, claimed to be the world's largest producers of carbon-black. Some of the key technical positions, at the outset, will be manned by specialists from the Boston plant, but Canadian personnel will be utilized to the greatest possible extent in the maintenance of an employee staff of from 50 to 60. Although operations at Sarnia will require their own analytical and control laboratories, those of the parent company will be called upon for basic technical assistance and facilities for research and development work.

Louis W. Cabot, grandson of Dr. Godfrey L. Cabot, who founded and was the first president of the company at Boston, will direct the construction and operation of the Sarnia plant; having been recalled to this side of the Atlantic from England, where he was in charge of construction and processing at Ellesmere Port. Procurement and purchasing of supplies will be handled by the Sarnia office. The fabrication of special equipment in the United States will be held to a minimum. Purchases of materials and supplies in excess of one million dollars will be made from Canadian sources. —H.C.P.

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Deep Rock Oil to Build New Lubricating Plant

Deep Rock Oil Corporation has awarded a contract to the M. W. Kellogg Company for a new lubricating oil plant to be built at its Cushing, Oklahoma, refinery, W. J. Carthaus, vice president, manufacturing and research division, announced. The new unit will utilize the propane deasphalting and the phenol solvent refining processes to produce high quality lubricating oils. Its capacity will be 930 bbl daily of finished oils, a substantial increase over the existing lube oil plant.

Deep Rock also will continue with the production of the "G" cylinder stock in increased quantities.

Certain auxiliary facilities for the new lube plant such as additional tankage, water cooling tower, and other off-site units, will be constructed by The Refinery Engineering Company of Tulsa.

Deep Rock's Cushing refinery with its 18,000-bbl daily capacity, has undergone many changes in the post-war period. Major new construction recently completed includes a crude still, Fluid catalytic cracking unit, office buildings, and a research laboratory.

Recently the company announced that construction would start soon on a new blending and packaging plant for motor oils. The chemical plants division of Blaw-Knox Construction Company has the contract for this refinery addition.

Imperial Oil Begins $13,500,000 Expansion

A $13,500,000 construction program at Imperial Oil's Ioco refinery will begin early this spring, it was announced by Charles Scrymgeour, superintendent of the refinery. Preparation of the site will get underway within the next few weeks and erection of the new equipment will begin in the fall. It is hoped the work will be completed in the late fall of 1953. The enlarged refinery will process crude oil brought from Alberta by pipe line.

When the expansion program is completed the refinery will have a capacity of 22,500 bbl a day, compared to 12,000 bbl a day now.

The new equipment will replace most of the existing process units. It will include a Fluid catalytic cracking unit, with a capacity of 7500 bbl per day.

America Seen as Entering Synthetic Liquid Fuels Era

Chemicals are the key that will unlock the door to establishment of an American synthetic liquid fuels industry, and that door will be unlocked sooner that most people think, the research manager of Koppers Company, Inc., declared in Pittsburgh, Pennsylvania, recently.

Dr. G. F. D'Alelio announced that Koppers Company is forming a coordinated fuels processing section of its research department. This section is designed to accelerate the pace of Koppers research not only in coal carbonization in which it has been engaged since 1907, but to probe more deeply the gasification and hydrogenation of coal, with particular emphasis on the chemicals that may be produced.

Koppers currently is building a pilot plant at its new Verona, Pennsylvania, research center to make gasoline from coal by the hydrogenation process. This process uses powdered coal in a slurry as raw material, the reactions taking place under high pressure. Gasoline of aviation rating can be made by this system, but a long list of aromatic chemicals such as benzene and other hydrocarbons, as well as phenols and cresols may be obtained in the process.

Device for Treating Water

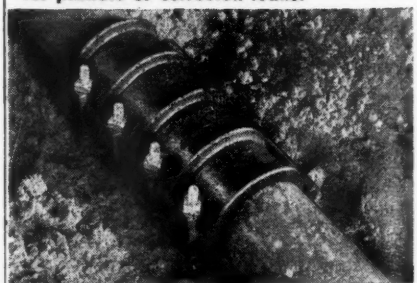
A $2000 award has been shared by two General Petroleum Corporation employees who suggested an improved device for treating water at the company's Torrance refinery. Paul Dorrin, a pipefitter, and Victor E. Thomson, a glassblower, designed and built a glass mixing device that more effectively mixes a chemical into cooling tower water. The chemical, liquid bromine, kills bacteria and algae growth and prevents fouling of the water circulation system.

In the 14 places throughout the General Petroleum refinery where the new device is installed about 80,000 lb of the chemical will be saved annually.

TO REPAIR PIPE LEAKS—QUICKLY, PERMANENTLY

ANY PRESSURE — ANY TEMPERATURE

SKINNER-SEAL EMERGENCY PIPE CLAMP for pinhole or corrosion leaks.



SKINNER-SEAL PIPE LINE CLAMP for long splits and bad corrosion leaks.

In stock—all supply stores

M. B. SKINNER COMPANY
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Phillips Acquires Alamo

Phillips Petroleum Company has acquired all interests in Alamo Chemical Company previously held by The Borden Company and General Aniline and Film Corporation, according to K. S. Adams, chairman and Paul Endacott, president of Phillips. Press reports indicated some weeks ago that there had been preliminary discussions among the three stockholder corporations relating to erection of manufacturing facilities by a jointly owned organization.

Phillips Chemical Company is beginning construction immediately on the large plant which Alamo had projected for producing ammonia, methanol, and other chemicals made from petroleum raw materials. The new plant will be situated on a 500-acre tract of land adjoining the present 340-acre site of Phillips Chemical Company's ammonium sulfate plant at Adams Terminal on the Houston Ship Channel.

Refinery Men Receive API Safety Awards

Nine top supervisors of the engineering-construction department of General Petroleum Corporation received two "Million Hour" accident prevention awards from the American Petroleum Institute recently.

Over 600 employees at General Petroleum's Torrance and Vernon refineries piled up the 1,229,521 accident-free man hours for a departmental award. The Torrance division received a separate award for its 1,041,211-hour record. The men are, left to right:

F. P. Lennon, Vernon superintendent, S. M. Lyon, T. J. Sullivan, L. H. Fosburg, John Tipps, A. H. Sievi, J. T. Rothenberger, Elmer Hayes, and B. C. McCoy, Torrance superintendent.

Texaco Adds New Lubricants

New Texaco high temp grease extends considerably the efficient range of operation of ball, roller, and plain bearings at high temperatures, The Texas Company announces. The new grease exceeds established military and industrial standards in affording unusual protection at temperatures up to 300 F for continuous operation and 350 F for intermittent operation. It far outran the hours-to-failure criteria of normal tests at 300 F and continued to exceed test specifications at even higher temperatures. An unusual characteristic of the new grease is the efficiency of its performance at high speeds as revealed in special ultra-high-speed endurance tests developed at Texaco's Beacon Laboratories.

Also, a new wire rope lubricant—Texaco Crater A—which because of its unusual penetration and adhesion properties will permit application to wet wire rope, has been developed by The Texas Company after extensive highly satisfactory field tests.

Pointing to considerable potential savings in railroad maintenance, Texaco has announced the Texaco rail joint lubricant, which affords several radical departures from similar lubricants now on the market. After extensive research and laboratory and field testing, the new product was released for sale fully qualifying as a rust-preventing lubricant that can be spray applied regardless of moisture conditions.

Texaco has introduced also an improved multi-purpose grease for use in general industrial applications—Texaco Multifak 2 Grease. It is recommended for use in situations that require one high grade multi-purpose grease for a variety of operations.

General Petroleum men get API safety awards.

CRA to Enlarge Refinery

Cooperative Refinery Association, Kansas City, Missouri, has announced plans for construction of additional facilities at its Phillipsburg, Kansas plant. Included in the new construction will be a Universal Oil Products Fluid catalytic cracker with complete gas concentration and polymerization units for maximum production of high octane gasoline from the cracking plant gases. Plans also include a gasoline treater for sweetening the catalytically cracked gasoline. The contract for construction has been awarded to Refinery Engineering Company, according to D. O. Givens, vice president of the latter.

The new cracking plant is designed to process cracking stock from 10,000 bbl per day of crude oil at 75 per cent conversion. Crude capacity at completion of the expansion program will be 8000 bbl per day with an ultimate crude capacity in excess of 10,000 bbl per day. When the new units are in operation, refinery products will include high octane motor fuels and distillates, as well as the usual straight run products.

Cooperative Refinery Association has been granted a Certificate of Necessity by the National Production Authority.

Trust Fund Set Up For National Research

Richard S. Morse, president, National Research Corporation, Cambridge, Massachusetts, has announced the formation of The National Research Corporation Scientific Trust to which a portion of the company's net income has been contributed for the year ending December 31, 1951.

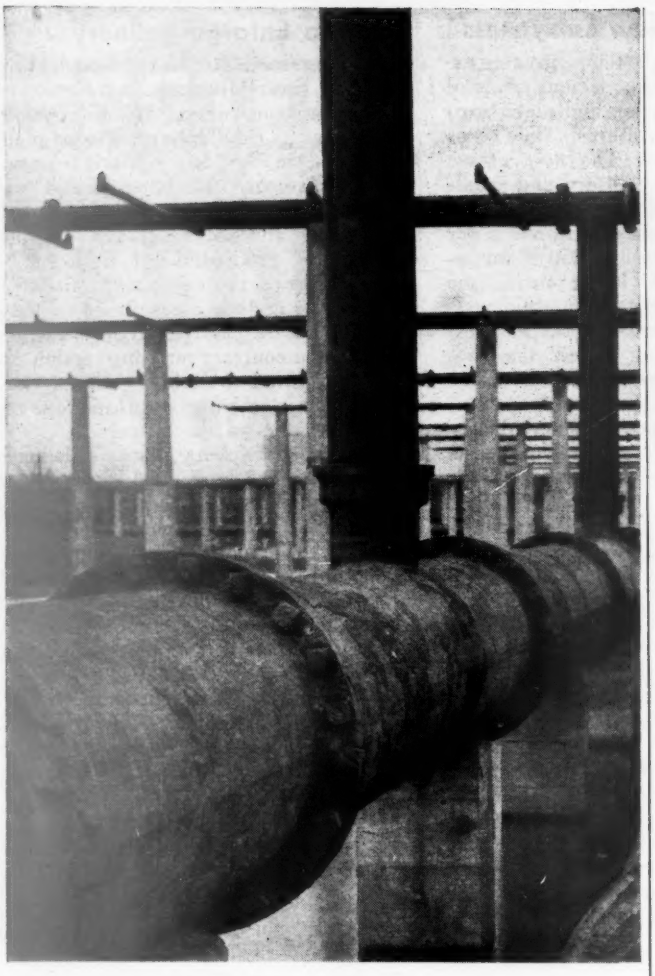
Morse stated, "There is a real need in this country for industrial support of unrestricted basic research work, and I believe that through the establishment of trust funds of this type, it will be possible to give effective aid on a long-term basis to fields of science that are so essential to the future of our expanding industrial economy."

Trustees of the fund are Dr. Julius A. Stratton, vice president and Provost of Massachusetts Institute of Technology; William A. Coolidge, chairman of the board of National Research Corporation; and Richard S. Morse, president of National Research Corporation.

Tide Water to Build New Distillation Unit

Edward H. Salrin, vice president Tide Water Associated Oil Company, has announced that construction of a new crude oil distillation unit designed to process 15,000 bbl of crude oil per day, has been authorized for the company's Drumright, Oklahoma, refinery.

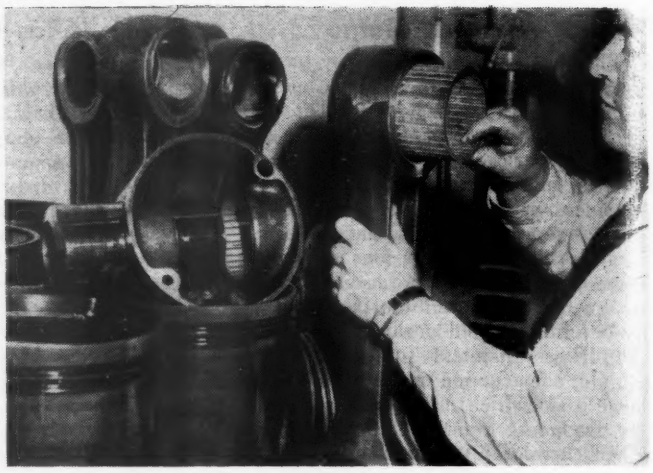
It is to include both atmospheric and vacuum distillation sections and to produce motor gasolines, burning oils, fuel oils, and charging stock for catalytic cracking to high octane gasoline. The unit is to be built by Born Engineering Company of Tulsa, Oklahoma. Work is to begin early in 1952.



AN ECONOMY FACTOR
IN REFINERY OPERATION

Proved long life and stubborn resistance to corrosion make cast iron pipe a contributing factor in lowering plant maintenance per barrel of crude. Replacing shorter-lived pipe with cast iron pipe has demonstrated this in many refineries. Cost per term of service decreases. Interference with production, caused by frequent replacements, ceases to be a headache. Cast iron pipe works hand-in-glove with plant management to keep maintenance cost down in many refinery operations. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY



Inserting a grooved silver, wrist-pin bushing into a connecting rod from a six-cylinder, 600-hp locomotive diesel engine.

Large Diesel Test Engine in Operation

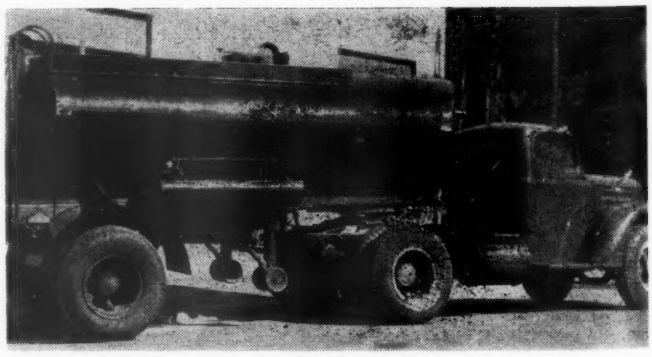
A huge, six-cylinder, 600 hp diesel engine, practically identical with those of higher power installed in railroad locomotive engines, has been in operation already more than 3000 hours, consuming more than a barrel of diesel fuel per hour, in the research and development laboratories of Shell Oil Company at Martinez, California. This engine is used to study the properties of lubricating oils and the requirements for heavy duty lubricants employed to lubricate these large power plants.

This engine weighs 30,000 lb or 15 tons, is based on concrete resting on a cork bed to minimize vibrations, and has operated the equivalent of 120,000 railroad miles. Although consuming a 42-gal barrel of fuel per hour it uses only one quart of diesel lubricating oil in that time. It is loaded by a standard dynamo and generates enough current to satisfy the needs of a town of considerable size.

Mineral Wool Keeps Asphalt Hot in Transit*

Mineral wool blankets, a common insulation on asphalt storage tanks, take to the road on tank trucks to keep asphalt hot for long periods enroute. In the photo, the 2500-gal tank on a transport trailer built by the Lechmere Construction Company of Cambridge, Massachusetts, is insulated with 2-in.-thick blanket-type mineral wool to maintain asphalt temperatures as high as 450 F. Hot air passing from small oil burners through heater tubes supplies the heat.

The blankets, with wire netting on both sides, are secured to

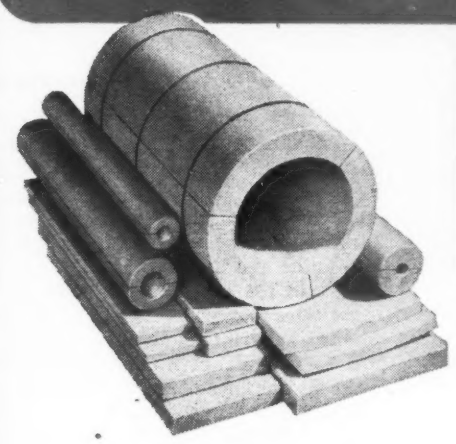


the tank's curved surfaces by ¾-in. galvanized metal bands spaced at 12-in. intervals along the length of the tank. On the ends of the tank, 9-gage galvanized wires approximately 4-in. long (one wire per square foot) are stud-welded to the tank surface. The 24 by 48-in. blankets, staggered so as to break joints, are impaled on the wires.

The method of insulating Lechmere's asphalt tank is designed for application to trailer tanks carrying high-temperature liquids throughout the chemical and petroleum industries.

*Industrial Mineral Wool Institute.

Pattern for the Future...



MODERN CONSERVATION PROJECT—the new Snyder Gasoline Plant, Snyder, Texas, operated by Sunray Oil Corp. for some 30 companies and 60 individuals. Plant-process heating equipment and steam lines are insulated with Kaylo Heat Insulation. General contractor—The Fluor Corporation, Ltd., Los Angeles, Calif.; insulation contractor—Industrial Insulators, Inc., Houston, Texas.

Leading Refiners Are Switching to KAYLO HEAT INSULATION

The growing trend to Kaylo Heat Insulation is a logical result of the outstanding combination of advantages offered by this revolutionary heat-saving material.

Kaylo Heat Insulation, a hydrous calcium silicate, has high insulating value over a wide temperature range. It is *effective* up to 1200°F.—thus eliminating the need for combination coverings in nearly all operating conditions.

In addition, Kaylo Heat Insulation has these excellent physical characteristics: it is insoluble in water and incombustible. It has dimensional stability . . . high strength . . . light weight — properties vital to a superior heat insulation.

Its ease of handling, cutting and fitting simplifies application—saves time on the job. With these important extra advantages, *at no extra cost*, little wonder that leading refiners are switching to Kaylo Heat Insulation.

For complete details on Kaylo Heat Insulation, write Dept. N-248, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

SEE OUR CATALOG IN THE REFINERY CATALOG

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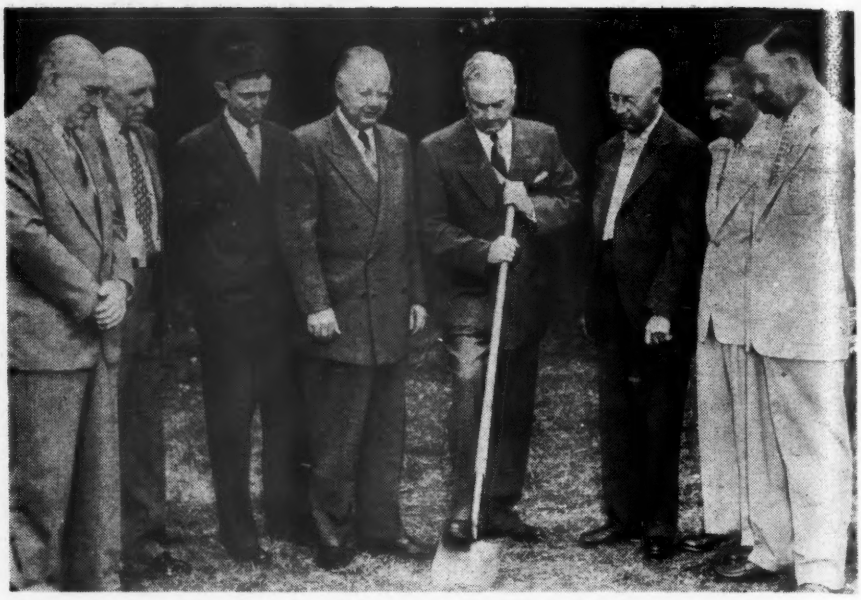
Cities Service Has First Orthoflow Unit in U.S.

The first Orthoflow catalytic cracking unit in the United States is now in operation at Cities Service Oil Company's Ponca City, Oklahoma, refinery. Shakedown runs were completed at the turn of the year, with regular operations reported under way.

The 8350-bbl-per-day cat cracker is one of the major elements in a multi-million-dollar expansion and modernization program which was begun last February and which is expected to step the Ponca City refinery's capacity up to 20,000 bbl of crude per day.

Designed and installed by the M. W. Kellogg Company, the catalytic cracker will be the second such unit to be put into operation on the continent. The first installation was completed last summer in Edmonton, Canada.



William B. Logan breaks ground for new Texaco building.

Texas Petro-Chemical Projects Planned for '52

During 1951, the Texas coast area and Louisiana boasted 85 per cent of the nation's petro-chemical facilities. Compared with the fact that in 1939 practically no organic chemicals were produced in Texas, makes the jump an important one. This was revealed in Charles E. Simons', executive vice president, Texas Mid-Continent Oil and Gas Association, year end appraisal of the industry.

Late in the year DuPont laid plans for a new petro-chemical plant along the coast, reportedly at a cost of at least $100,000,000. Union Carbide is expected to invest $130,000,000 in plants along the coast.

Plant projects either planned, building, or completed during 1951 involved about $480,000,000, including DuPont and Union Carbide. This figure includes activities of 10 new companies, in addition to the 43 companies that were operating 51 petro-chemical plants at the beginning of the year. Since that time, 27 new projects have made their appearance, in some form or another.

The following table is a rundown of the plants along the Texas Gulf Coast, planned, begun, or refined, major products, and approximate costs:

Company	Location	Products	Approximate cost
Alamo Chemical	Houston	plastics, anti-freeze etc.	not announced
Atlantic Refining	Atreco	detergent base	not announced
Celanese Corp.	Bishop	Trioxan, paraformaldehyde	$ 3,500,000
Dow Chemical	Freeport	ethylene	3,100,000
Dow Chemical	Freeport	perchloro-ethylene	5,000,000
Du Pont	Victoria	nylon salts	not announced
Ethyl Corp.	Houston	sodium, chlorine, ethyl chloride, tetraethyl lead	45,000,000
Ethyl-Dow	Freeport	ethylene dibromide	8,000,000
Gulf Oil	Port Arthur	isooctyl alcohols	700,000
Gulf Oil	Port Arthur	ethylene	15,500,000
Hayden Chemical	Houston	methanol	12,000,000
Kolker Chemical	Houston	benzene	not announced
Koppers	Port Arthur	various petro-chemicals	6,500,000
Lubrizol	Houston	lube-oil additives	2,000,000
Monsanto	Texas City	styrene, acryloniprile hydrogen cyanide	8,500,000
Monsanto	Texas City	styrene, acryloniprile hydrogen cyanide	25,500,000
Pan American	Texas City	benzene	1,000,000
Phillips	Houston	various petro-chemicals, ammonia, methanol, acetylene	4,000,000
Phillips	Houston	various petro-chemicals, ammonia, methanol, acetylene	38,500,000
Shell Chemical	Houston	ethyl chloride	not announced
Shell Oil	Houston	benzene	10,000,000
Union Carbide	Texas City	benzene	7,500,000

Test Run Termed Successful At Gas-Synthesis Plant

Completion of the second integrated test run of the new Bureau of Mines gas-synthesis demonstration plant at Louisiana, Missouri, was announced recently by Secretary of the Interior Oscar L. Chapman. Lasting for 25 days, this run marked a milestone in a program of technologic and scientific research which has greatly improved a German technique for producing gasoline and other liquid fuels from coal and adapted it to American conditions.

Although the primary purpose of the run was to show that all phases of the process and equipment were operable and no attempt was made to obtain maximum production, John J. Forbes, Bureau Director, said that appreciable quantities of representative products were made. Sufficient amounts of motor-grade gasoline and of diesel oil were produced in barrel lots to allow for their practical testing and evaluation. During the run more than 52,000,000 cu ft of synthesis gas was made and treated to yield the synthetic fuel products. This amount of gas required more than 700 tons of coke and 450 tons of 95 per cent pure oxygen.

Texaco Begins Work on New Administration Building

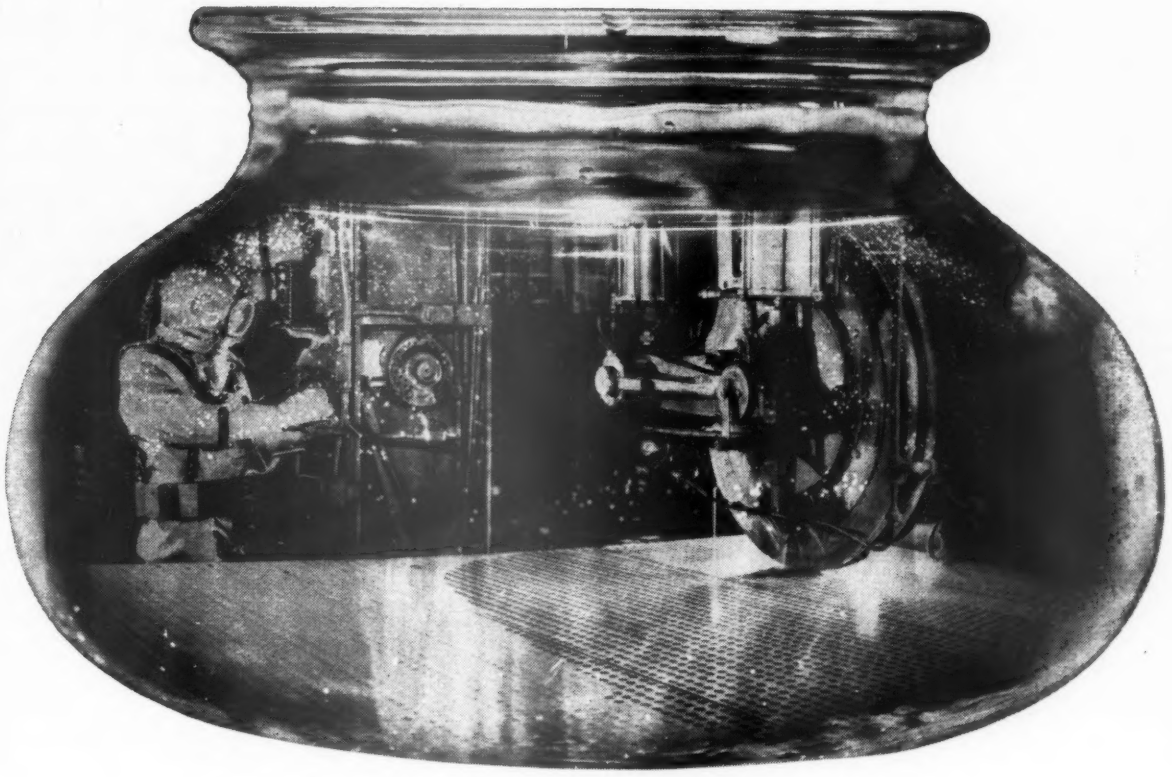
Coincident with the twentieth anniversary of the Beacon Laboratories of The Texas Company, William B. Logan, Texaco's manager of refinery operations, turned the first shovel of earth for a new administration building. Joining Logan in the ceremony signalizing the event (see photo) were: Carl E. Cummings, superintendent of the laboratories; Joseph F. Connor, the oldest Texaco employee at the laboratories and now assistant to the superintendent; R. K. Fiestsam, assistant superintendent; Dr. Wayne E. Kuhn, manager of the company's technical and research division; Logan; Leonard J. Supple, chairman of the Dutchess County (New York) board of supervisors; Mayor J. Lewis Bolton of Beacon, New York; and Mayor G. William Luther, Jr., of Fishkill, New York.

The two mayors represented the neighboring communities. The new building will provide 23,000 sq ft of new floor space badly needed for research projects directly related to national defense. Logan, who helped activate the laboratories in 1931, indicated that the new three-story structure would probably be completed early in 1953.

Technical Reports Index Out

Volume 15 of the Bibliography of Technical Reports (January-June, 1951) is now indexed according to subject, the Office of Technical Services of the U. S. Department of Commerce has announced.

Copies of the Subject Index to Volume 15 may be purchased from the Office of Technical Services of the U. S. Department of Commerce, Washington 25, D.C., at $1 per copy. Still available from O. T. S. at $1 each are the indexes to Volumes 6, 7, 11, 12, 13 and 14. Check or money order payable to the Treasurer of the United States should accompany all orders.



Instantaneous water quenching of spot-welds, bonding stainless liners to carbon steel plate, is just as effective as though it were done submerged in a fish bowl!

Resistance welding under water

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An exclusive A. O. Smith technique makes sure that stainless lining spot welded to carbon steel plate, retains its original corrosion-resistant properties in process equipment.

Closely and precisely spaced spot-welds that inseparably bond the liner to the load-bearing vessel walls are instantly quenched in water at the time of welding. The interval of critical temperature is so short that preferential attack is avoided.

The automatic equipment employed in this operation is A. O. Smith designed and built. Simultaneously, it joins liner to base under great hydraulic pressure, applies the welding current and floods the spot with quenching water.

No wonder SMITHlined pressure vessels have records of more than twenty years in corrosive service without failure.

For assurance of superiority in vessel design and construction, and for aid in solving vessel application problems, call on A. O. Smith where the industry's leading laboratory, design and engineering groups are at your service.

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To obtain more information on products advertised see page E-41

Canadian Refining to Double in 8 Years

Canada's leaders in science and industry, in yearly statements, have stressed the technological developments and construction advances in the petroleum and natural gas fields as distinct contributions to the over-all expansion of this country's economic stability through the last year.

Reviewing the activities of the National Research Council of Canada, in fuels and lubricants investigation and resulting benefits sought for the aviation and automotive industries, Dr. C. J. Mackenzie, president of the Ottawa body, observed:

"Development of special types of fuels and lubricants to meet cold weather requirements entails much painstaking research. Refinery cracking processes yield distillates containing considerable amounts of unsaturated aromatic compounds. As it is desirable to be able to utilize a wide range of distillates, it is of importance to be able to control the formation of carbon from a given fuel. One possible way of doing that is to add small amounts of certain substances to the fuel.

☆ ☆ ☆ ☆

"Corrosion of metals is a long-term study in which the Directorate of Vehicle Development has considerable interest. A survey is currently being made of the various types of corrosion inhibitors used in automotive cooling systems. Typical inhibitors proposed for use in new and reclaimed anti-freeze solutions are being tested in the laboratory for their corrosion effects on materials used in vehicle cooling systems.

☆ ☆ ☆ ☆

"Investigations are proceeding on the quality of motor-vehicle paints available for use on Army vehicles. In addition to the ordinary work on paints, new test methods are being developed for the assessment of insulating varnishes, finishes for electronic equipment, undercoatings for vehicles of fire retardant paints for use especially on wooden and other structures, where fire hazard is an important consideration."

Dr. Mackenzie described a co-operative form of investigation now under way on gas turbine-engines from the United Kingdom. Each year, he stated, a number of the latest turbo-jets and turbo-propeller-engines are brought to Ottawa, where their icing characteristics are examined. Staff from the United Kingdom participate in the program. "This," he notes, "is a most advantageous arrangement, as it brings to the laboratories the most up-to-date types of engines for study and provides equipment that subsequently can be used in various other tests".

"An examination of construction projects reveals a significant turning-point in the direction of new investment," the president of Canadian Industries, Ltd., H. Greville Smith, stated, adding:

"In the field of petroleum chemicals, the largest undertaking in Canada today is a project for the manufacture of chemicals used in the production of cellulose, acetate, and other materials. Natural gas may also be the means of starting new production of a plastic, polythene, which already is used extensively for packaging and insulating. Other chemicals are to be manufactured partly or wholly from petroleum raw materials, including ethylene glycol, acetone, isopropyl alcohol, formaldehyde, pentaerythritol, and phenol. From a petroleum fraction come also chemical intermediates for nylon manufacture.

☆ ☆ ☆ ☆

"Elemental sulfur that has become the most pressing shortage, will be manufactured from sour natural gas in two plants under construction in Alberta. In addition, liquid sulfur dioxide will be made from smelter fumes in Ontario. . . . A new plant is being erected and existing capacity is being expanded at several locations to meet the increased demand for sulfuric acid . . . By the end of 1952, such measures will add the equivalent of 100,000 tons of elemental sulfur to Canada's supplies."

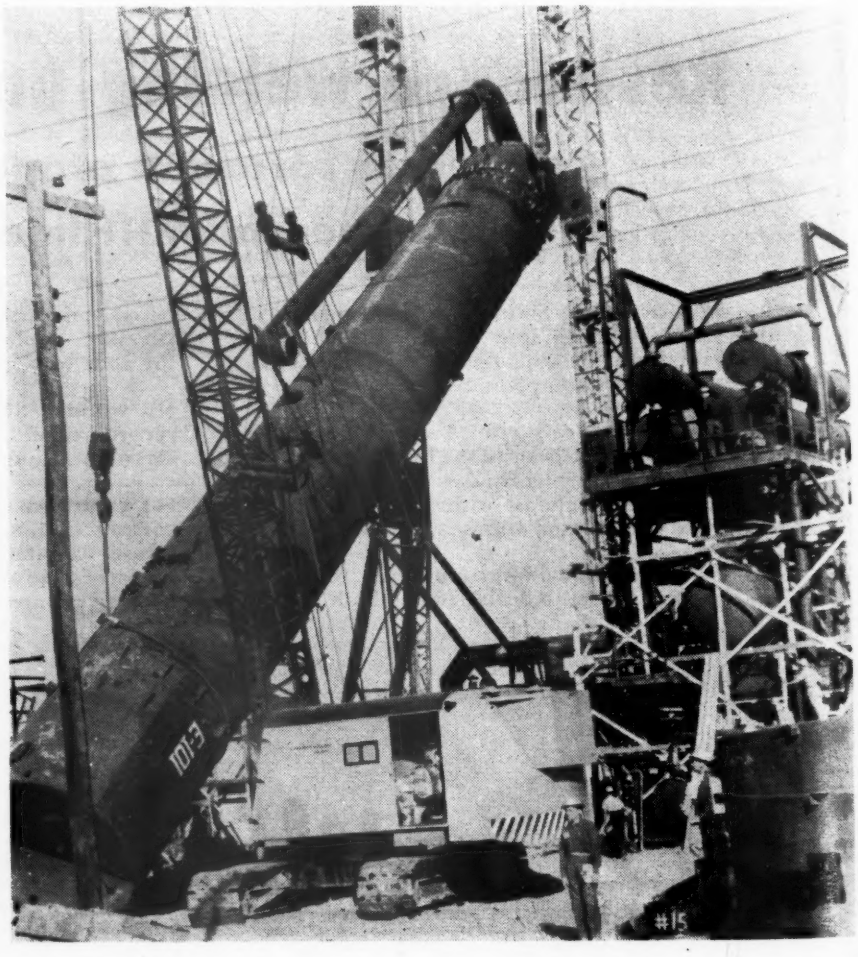
Reporting the completion during 1951 of three new refineries—two at Edmonton, one at Winnipeg — G. L. Stewart, president, Imperial Oil Limited, declared the total number of refineries operating in Canada to be 38. Said he:

"Capacity was increased at a number of existing refineries, with the result that, today, this country can refine approximately 389,000 bbl a day compared with 216,000 bbl daily in 1945. Refinery construction is continuing and by 1953 capacity is expected to reach 435,000 bbl per day . . . In 1947-51 inclusive the Canadian oil industry spent one billion dollars on capital investment, three quarters of that on western developments . . . In 1945 consumption was 70,000,000 bbl; by 1950 it had risen to 130,000,000 and in 1951 Canadians used almost 150,000,000 bbl—or a gallon a day per person. This is the second highest rate of consumption in the world, being exceeded only in the United States."

Orthoflow Fluid Unit Nears Completion Date

Main fractionator has been raised for the new Orthoflow Fluid catalytic cracker now under construction for Canadian Oil Refineries, Ltd., at Froomfield, Ontario, by The M. W. Kellogg Company's subsidiary, Canadian Kellogg Company, Ltd. An important part of the new refinery being built under the overall supervision of Stone and Webster Canada, Ltd., the unit is scheduled for completion in March. The output of the refinery will be handled by Canadian Oil Companies, Ltd., parent company of Canadian Oil Refineries.

Raising main fractionator at Froomfield, Ontario, Canada.



—PERSONALS—

J. F. (Jack) Canning is the new president of the Southwestern Petroleum Company of Fort Worth, manufacturer of specialty lubricants, oils and heavy-duty asphaltic roof coating and other products for preservation of structures. **J. W. Shugart, Jr.,** was elected executive vice president. He had been vice president of the company since 1941.

Orville H. Utley is the new vice president. He will also retain the post of sales manager, which he has held since 1948.

Canning succeeds **E. H. Beall,** who has been president of the firm since he founded it 17 years ago. Beall will continue as chairman of the board of Southwestern.

In 1937 Canning became sales manager of a new division of Southwestern—The Zone Company. He was made vice president of Southwestern in 1943 and executive vice president six years later. He studied at Texas Christian.

Southwestern's new executive vice president, Shugart, has been with the company since 1940. Previously, he had been with the Waples-Platter Company, Fort Worth, for eight years and for four years had a Chevrolet dealership in Bryan, Texas. The company's new vice president, Utley, joined Southwestern in 1938. For seven years just before joining Southwestern, he was assistant merchandising manager for the Williamson-Dickie Manufacturing of Fort Worth.

Beall founded the company in 1934 after retiring from other business activities in Fort Worth.

Harry M. Brubaker has been appointed assistant sales manager of the Carbon Black division of Witco Chemical Company. He will occupy offices at 311 Evans Building in Akron, Ohio. Before joining Witco, Brubaker was with B. F. Goodrich's Hycar Division, the Phillips Chemical Company, and the Sid Richardson Carbon Company.

P. W. Judah has been appointed manager of the lubricating department of Socony-Vacuum Oil Company, Inc. In his new position, he succeeds **Paul V. Keyser, Jr.,** who was recently appointed general manager, domestic marketing.

Judah, who has been manager of the industrial division of the lubricating department since 1949, has been associated with Socony-Vacuum since 1932, when he became a service station attendant at Elmira, New York. He was graduated as a civil engineer from Purdue University in 1928.

G. R. Monkhouse

G. R. Monkhouse, a 30-year man in Shell companies and presently general manager, western division of Shell Chemical Corporation, has been elected vice president, western division. Offices will remain in San Francisco.

Monkhouse began his career with Shell in 1921, served 3 years in England, 4 years in India, and 23 years in this country, broken only by wartime service in the U. S. Army. He progressed through various marketing positions with Shell Oil to division manager, became general manager of Shell Chemical's eastern division, and in 1948, general manager of the western division.

John T. Doyle

John T. Doyle has been appointed manager of the natural gas and gasoline division for Shell Oil Company in Los Angeles. Doyle, who began his career with Shell in 1933 as a roustabout in Long Beach, succeeds **R. S. Tulin** who has been selected for special assignment by Shell's New York head office. Tulin continues his headquarters in Los Angeles but will spend full time on special natural gas and gasoline problems affecting the company's United States and Canadian operations.

Doyle received his electrical engineering degree from the University of Maryland in June, 1933, and joined Shell the following month. In 1947 he was made assistant manager of the natural gas and gasoline division and has served in that position until his recent promotion.

J. W. Morgan has been appointed as manager of British American Oil Company's Montreal East refinery, succeeding the late R. F. A. Smith. A graduate of the University of Alberta in chemical engineering, Morgan joined British American at Calgary refinery in 1939. After holding several positions in the manufacturing department he became administrative assistant to the manager of manufacturing in 1949. He was appointed assistant manager of the company's Moose Jaw plant last year.

Morgan has been on loan to the Department of Defense Production, petroleum division, for the past six months, during which time he was on specific assignments in Washington, D. C.

E. H. Beall

J. F. Canning

J. W. Shugart

O. H. Utley

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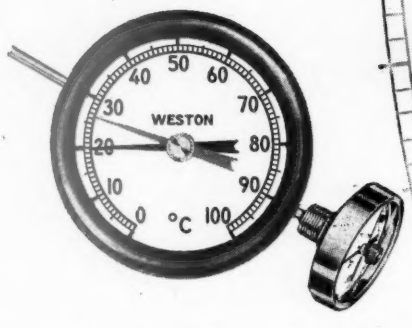

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Equipped with a manually set red index which moves up or down scale with pointer, remaining at extreme temperature reached until reset. Thus one reading gives present temperature, and maximum or minimum reached since last reading. Available in scale lengths of 6" and 9"—stem lengths 2½" to 24".

Literature describing Weston all-metal, as well as electrical and glass thermometers, sent on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

WESTON *Instruments*

C. W. Turner has been elected president of American Bitumuls and Asphalt Company, and **C. W. Stewart** to the newly-created position of vice chairman of the board of directors. Stewart has been president of the company, a subsidiary of Standard Oil Company of California.

Turner has been Standard's Honolulu district manager since 1940. Before going to Honolulu, he was assistant manager of the company's lubricant division.

American Bitumuls and Asphalt Company, with headquarters in San Francisco, is a nation-wide organization with fourteen district offices, including plants and refineries for the manufacture of asphalt, Bitumuls, and emulsified asphalt throughout the United States, and in Puerto Rico.

Dr. Jesse Werner has been appointed technical assistant to the vice president, operations, General Aniline works division, General Aniline and Film Corporation. Dr. Werner, in his new responsibilities, will assist on the planning of various technical aspects of GAW's operations, including research and market research and development. Additionally, he will maintain close contact with all phases of the division's acetylene program. Dr. Werner was formerly assistant manager of the process development department at GAF's Grasselli, New Jersey, plant. He has been with GAF since 1938, joining the company after obtaining his Ph.D. at Columbia University.

Harold E. Reppen has been promoted to group leader in technical service at the Whiting, Indiana, research laboratories of Standard Oil Company (Indiana). Reppen joined the company in 1943 as a chemical engineer following graduation from University of Illinois.

Robert T. Baldwin has been named executive secretary and assistant treasurer of the Association of Consulting Chemists and Chemical Engineers, Inc. **A. B. Bowers** is the new director of publicity and assistant executive secretary.

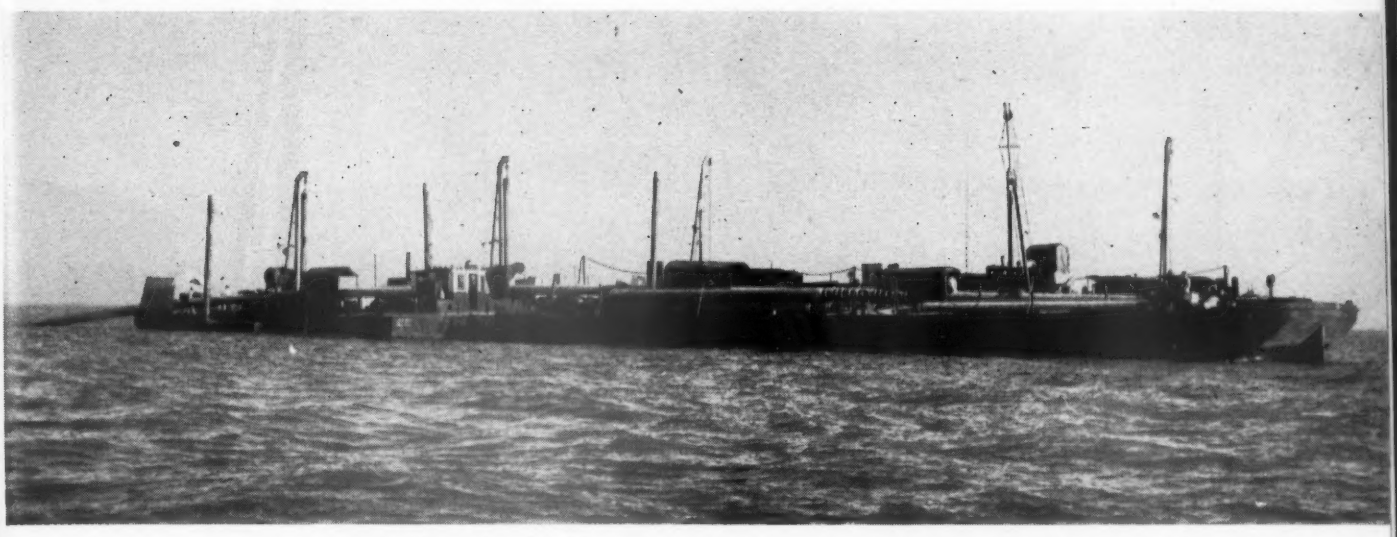
Shell Tests Diesel Engine

The West Coast's only stationary test locomotive engine has now "traveled" the equivalent of 120,000 miles.

This trackless diesel engine was installed last spring at the Martinez research laboratory of Shell Oil Company for testing lubricants and fuels. It dwarfs other automobile and industrial engines in adjacent rooms and is exactly the same engine as those in standard switching locomotives seen in rail yards the country over.

Already the initial tests with the stationary engine at Martinez have contributed to the development of new lubricants that will allow locomotives to remain on the job for years without a major overhaul.

According to Shell engineer, F. H. Caudel, the locomotive engine consumes a barrel of diesel fuel an hour but uses up only about a quart of lubricating oil in the same time.



Laying and supply barges with pipe coming off the laying barge as it is lowered into the bay.

Longest, Largest Line Laid in Galveston Bay

Light steel barges employed for 10-mile, 18-in. crossing installed for Pan-American Gas Company

FRANK H. LOVE*

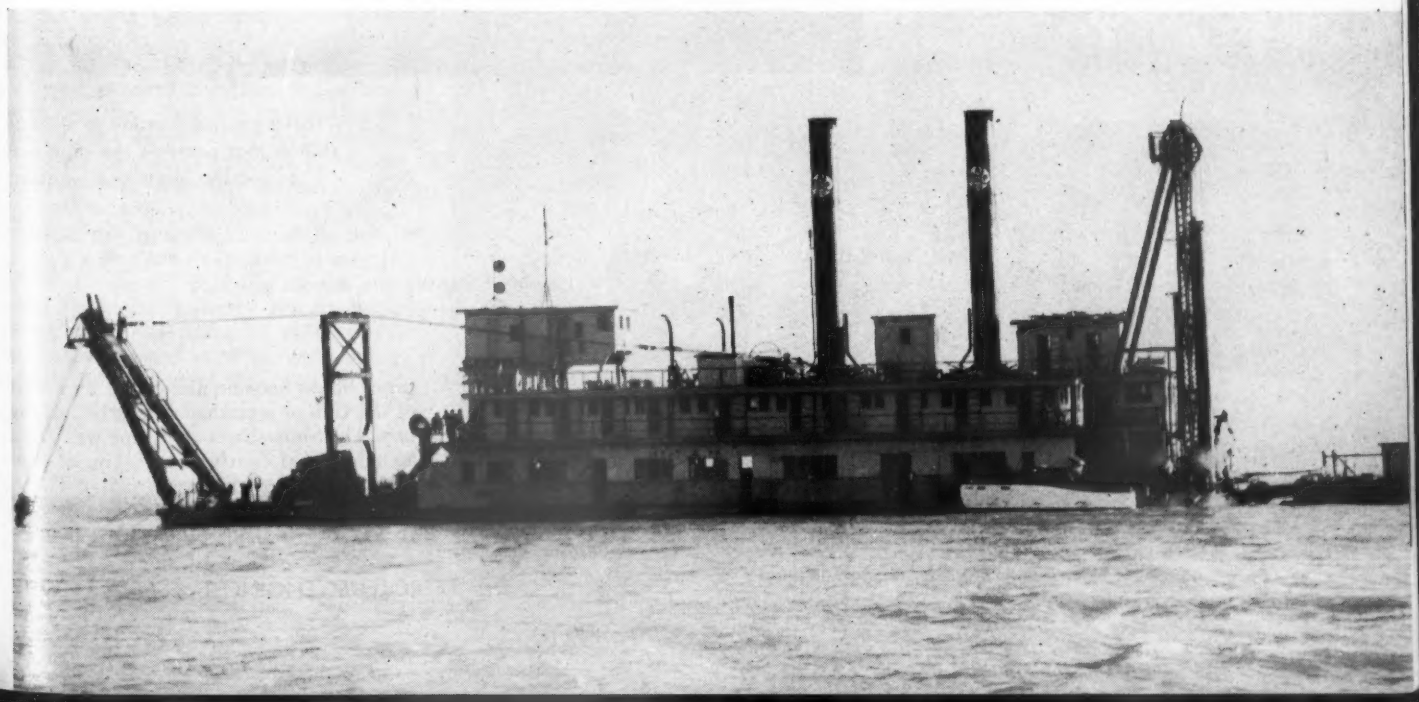
ALTHOUGH there are a number of oil and gas pipe lines beneath Galveston Bay, the 18-in. just installed by Pan American Gas Company has the distinction of being the longest and of greatest diameter. It also is the largest diameter pipe to be laid from light barges under any considerable stretch of water. The length of the crossing is 10 miles.

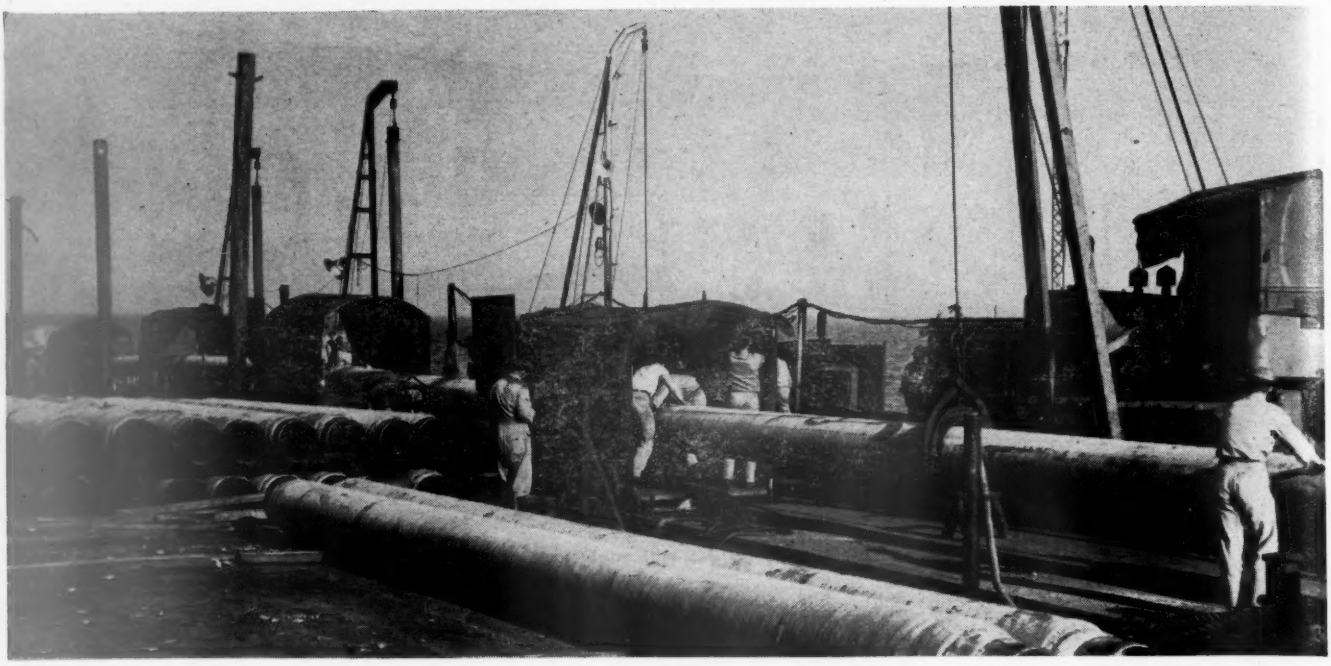
Extending from Smith Point to Dollar Point, the bay crossing is part of a gas system from Winnie, Texas, to Pan American's terminal at Texas City. It is important because it gives the company a second line to the Texas City industrial area and provides a supply safety factor. Pan American for a number of years has had a 16-in. line from the Chocolate Bayou field with a capacity of 170,000,000 cu ft a day. The new line has a designed capacity of 110,000,000 cu ft a day. The gas comes from the Greater Sea Breeze area in Chambers and Jefferson counties and is contracted

*Editor, Oil and Gas Pipelining.

EXCLUSIVE

The huge dredge—largest ever seen in the Gulf—used to dredge beneath the Houston Ship Channel.





Pipe supply barges in foreground with covered welding stations shown along side laying barge. A joint of pipe is being lined-up.

from the Sun Oil Company. Transmission to the east side of the bay is through a 34-mile 16-in. pipe line, and from the west side of the bay to Pan Am's terminal through an additional 6 miles of 16-in.

Construction of an underwater pipe line necessitates considerable study and planning before the project can even get under way. This is particularly true if the body of water contains marine life and is used to any great extent for navigation. In this particular instance both factors had to be considered. Observations and tests have revealed that barnacles will not form on pipe or other structures at a depth of approximately 2 ft or more below the silt line, therefore it was decided that the line should be given a cover of 4 ft. Greater depth was required under the Houston Ship Channel, which cuts across the bay; here the pipe was buried 50 ft below mean low tide. Although the 4-ft depth will protect against marine life so long as the pipe remains covered, a further safeguard was provided in event the pipe should become uncovered by action of the tide or a change in the bed of the bay. The Somastic-coated pipe was given an additional coating of 1¼ in. of concrete. This hard material cannot be attacked successfully by marine life and should provide the pipe with adequate

Making a weld inside a tent-like station that protects the pipe and welders from bad weather.

Pouring Somastic into a mold to cover joint after welding.

Wire mesh being placed over Somastic to give reinforcing to concrete that is yet to come.

protection, plus the additional weight necessary to give it a negative bouyancy.

The pipe used in the crossing has a wall thickness of ½ in. and came in 40-ft joints. Most of the pipe was given a ⅝-in. coating of Somastic plus a 1¼-in. coating of concrete, as mentioned. Approximately 4000 ft of pipe on either side of the Houston Ship Channel was given a coating of 1¼ in. of barytes over the Somastic instead of the regular concrete. This was for additional weight to make certain that the pipe would not float up in the very soft spoil on either side of the channel. The H. C. Price Company did this work at its Harvey, Louisiana, plant and the pipe was shipped to location through the Intercoastal Canal.

Rather than use bends in the pipe to attain proper depth beneath the ship channel, the approaches were dredged on a slope. The amount of silt and muck that had to be removed from the bottom of the bay to form this slope in the proper manner for the pipe to be supported naturally without undue strain required one of the largest dredges ever employed for this type of work in the Gulf Coast area. Through the ship channel area cast-iron river clamps were installed for a distance of approximately 800 ft. These weighed 2100 lb each and were placed on 32-ft centers. These were an added precaution to provide for ample negative buoyancy in this critical area.

The pipe that was coated with Somastic and concrete weighed 208 lb per foot; that coated with Somastic and barytes 229 lb per foot. The negative bouyancy of the pipe laid in the bay was 25 per cent, and that under the ship channel, with river clamps added, was considerably greater. Weight of the latter with clamps installed was 274 lb per foot.

The barges employed in laying operations were 110 ft long by 25 ft wide, constructed of steel and having a shallow draft, as the bay normally is only 4 to 10 ft in depth. Four barges were used, two being secured together as the laying barges, the other two being used as pipe supply barges. The front laying barge was in a level position, the back one sloped to facilitate lowering the pipe into the bay. A pipe barge was lashed to the laying barges at all times and as a new joint was needed it merely picked up by a sideboom tractor stationed on the laying barge and lined up for welding. The joints of pipe rested on a series of steel saddles while being welded. After a joint was welded, the

Pouring concrete into mold around pipe joint. This will give the pipe protection against marine life.

Looking down center of laying barge, with power equipment used in moving barge at right and welding stations at left.

weld was X-rayed, the field joint was cleaned and primed, and then a special mold used to apply the Somastic. Wire mesh, which had been crimped approximately every 9 in. to space it midway in the concrete was attached around the Somastic coated field joint and a mold of galvanized iron fastened over this to the concrete coated pipe with flaps on the topside remaining open until the mold was filled with concrete. The flaps were then closed, and after a period of approximately 20 minutes the time required to complete all five operations the joint of pipe was lowered into the bay as the laying barges moved themselves forward and out from under the completed joint by means of winches and anchors. This elapsed time between the pouring of the concrete and lowering of the pipe did not give the concrete time to set completely. It was thought that the action of the water might wash out too much of the concrete for adequate protection before this was accomplished, however, early tests proved that such was not the case and that the setting up of the concrete was completed after being immersed in the salt water of the bay. Calcium chloride added to the concrete accelerated this process.

The Houston Ship Channel presented still another problem that that of burying the pipe to a depth of 50 ft. Being a busy artery of commerce, regulations will permit its being closed only 4 hours at a time. This meant fast work on the part of contractor. To handle the situation pipe was laid up to the ship channel from either side. The 1700-ft section of pipe required for the channel itself was welded into a single string using removable pontoons to lighten the weight to approximately 20 lb per foot, and when ship traffic was stopped this section was pulled across the channel into place. The two ends which had been marked with buoys, were then picked up and placed on barges where the tie-ins were made.

Despite the heavy weight of the pipe, and the difficulties encountered laying it in open water, good progress was made on the job. The work began November 5 and one 12-hour crew worked until November 26, at which time a second crew was added. The job was completed January 15, 1952. During this period the maximum number of joints laid in a day was 60, or 2400 ft of pipe.

When the crossing was completely laid, the pipe was buried to desired depth by jetting with the contractor's specially designed equipment that rides the pipe as it works.

As the line was laid a series of test leads were installed that can be used to make electrical current surveys for cathodic protection. Four leads were installed, one on either side of the ship channel and one on each section between the channel and shore. These leads also can be used for connections with anodes should it be decided, after the tests are made, that anodes should be used.

Another interesting feature of the project is the installation of a radio operated control valve on the east side of the bay, which is the upstream side. The valve will be operated from Pan American's terminal office at Texas City and will be used in event of a break in the bay crossing. Immediate stoppage of the gas flow through the line can thus be effected although the location of the safety valve is some 15 miles distant from the terminal office. The flow of gas through the line, incidentally, is entirely by well pressure, there being no booster stations.

When the new line reaches full capacity it is likely that selective telemetering equipment will be added to give close control of the system by making field and delivery pressures available at all times. Such a system is now being installed on the Chocolate Bayou line. Operating pressures on the Winnie line are 850 psi at Winnie, which drops to 650 psi at Texas City. These are the pressures for operating the line at the designed capacity of 110,000,000 cu ft a day.

Brown and Root of Houston, Texas, were the contractors for the Galveston Bay crossing. The dredging of the Houston Ship Channel area was sub-contracted to the Atlantic, Gulf and Pacific Company, and, as has been mentioned, the Somastic and concrete (Hevicote) coatings were applied by H. C. Price Company at its Harvey, Louisiana, plant. Both segments of the land line were constructed by Anderson Brothers Corporation of Houston. * * *

Big Motors for Pipe Lines

The Basin System is installing motors larger than previously used for pipe lines

RAYMOND F. HORRELL and EVERT H. JERNBERG

The Authors

Raymond F. Horrell is head of the induction motor design section of the Electric Machinery Manufacturing Company, Minneapolis, Minnesota. He is an electrical engineering graduate of the University of Kansas (1938), and a member of Tau Beta Pi and Sigma Tau. Joining Westinghouse Electric Corporation after graduation, he worked on the design and development of induction motors, with special attention during the war on silicone high temperature induction motor insulation, and published several papers on this subject. He also worked directly on designs for a new line of induction motors. Horrell has been with E-M since 1945 and is responsible for the electrical design and development of induction motors.

Evert H. Jernberg is chief mechanical engineer of E-M. A mechanical engineering graduate, in 1940, from the University of Minnesota and a member of Pi Tau Sigma and Tau Beta Pi, he studied under Prof. J. J. Ryan, an authority on photo-elastic stress analysis and vibration study. At the University of Pittsburgh, Jernberg took advanced work in elasticity under Dr. A. Nadai and hydromechanics under Dr. Stewart Way, and was a member of the mechanical engineering staff at Westinghouse Electric Corporation. He has been with E-M since 1945 and is responsible for the mechanical design and development of all rotating electric machinery.

In this article, Horrell prepared the section on "Electrical Design" and Jernberg that on "Mechanical Design."

When owners of the Basin Pipe Line System decided to materially increase the capacity of the Jal-Cushing pipe line, (Basin System), numerous factors led to the decision to obtain this major increase in capacity by adding four booster stations. These stations represent new, advanced pipe line engineering requiring larger motors and pumps than previously built for pipe line service. As finally designed, each station will use two multi-stage centrifugal pumps, each pump driven by a 3000-hp, 1780-rpm, squirrel-cage induction motor.

Electrical Design

The specifications required that the motors have a high efficiency and a reasonably high power factor to obtain low operating costs. The motor must develop sufficient torque to accelerate the motor and pump to full load speed under starting conditions and a breakdown torque of twice rated torque was required to insure proper operation under load. Full-voltage, across-the-line starting was specified for simplicity of control and operation.

The four booster stations are in Texas and Oklahoma and are supplied by four different power companies. As these stations are all a considerable distance from the power generating plants, any large amount of power required, such as that required under starting conditions, will produce an appreciable drop along the transmission line supplying the power. To be able to start the 3000-hp motors across-the-line with minimum voltage drop on the line is therefore of vital importance. Line disturbance must be held to a minimum to avoid inconvenience to other power consumers. The motors also must accelerate the pump under the worst possible condition of voltage drop that may develop during starting conditions and any motor that is running must carry its load during this period. This problem was studied at great length by the engineers of Texas Pipe Line Company, in consultation with engineers of the other carriers owning an interest in the Basin Pipe Line System, the power companies, and the motor manufacturer.

Across-the-line starting with minimum line drop required the use of high-impedance transformers feeding directly to the motors from the substation. Two stations required one 6000-kva, 3-phase transformers per station and two stations required two 3000-kva, 3-phase transformers per station (one for each motor). The impedance of the transformers is on the order of 8 per cent compared to 5 per cent as normally might be supplied. These high reactance transformers act as series reactors and serve to reduce the disturbance on the transmission line. The voltage drop at the motor upon starting is on the order of 22 to 30 per cent depending upon the line impedance, the transformer combination being used, and whether one motor is running when the second unit is started. The voltage drop in the line, however, is less than 10 per cent, which is considered satisfactory for the lines involved. In general, starting each motor from the individual 3000-kva transformer will give the least line drop, but the drop at the motor terminals will be greater than if the two motors are started from the one 6000-kva transformer.

To achieve the desired motor characteristics for this application, the design was a combination of several design factors. Any one of these factors may have affected the others in some manner. The starting current was kept as low as possible to minimize the line drop. This limitation for all practical purposes established the motor reactance. The reactance was the controlling factor of the breakdown torque, and had some effect upon the power factor. High efficiency was obtained by keeping the losses low. To see how the various design factors affected the losses and other characteristics, it is best to briefly discuss each one individually.

The stator copper loss depends upon the resistance of the windings and the current passing through the windings. The only way to appreciably reduce the stator copper loss is to reduce the resistance of the windings. This was done by using the minimum number of series conductors in the coil, by using the largest conductor that was feasible, and by obtaining the shortest conductor length possible. A short conductor length embodies a short end-turn extension, which in turn affected the motor reactance.

The stator core loss depends upon the grade of electrical sheet steel and its processing, the amount of steel used, and the flux density in the steel. The design of the stator laminations was a balance between the coil design and the magnetic circuit. The motors used a thin, high-grade, non aging electrical sheet steel having a low-loss specification. Each lamination was ground to remove the burrs and then coated with high-grade insulating varnish, which was baked. The amount of steel used was determined by selecting a length of stack that gave a suitable flux density and a suitable leakage reactance.

Included in the core loss are the high-frequency surface and tooth pulsation losses in the stator and rotor. These losses cannot be neglected and are affected by such items as the number of stator and rotor slots, the width of the slot openings, the air-gap, the grade of steel, and the flux densities in the various flux paths. The combination of these items used to achieve a minimum loss is beyond the scope of this article.

After fixing the design of the stator, it remained to arrive at the proper rotor-cage design to obtain the lowest loss (and slip) at rated load and, at the same time, to obtain the proper accelerating torque characteristics. The cage

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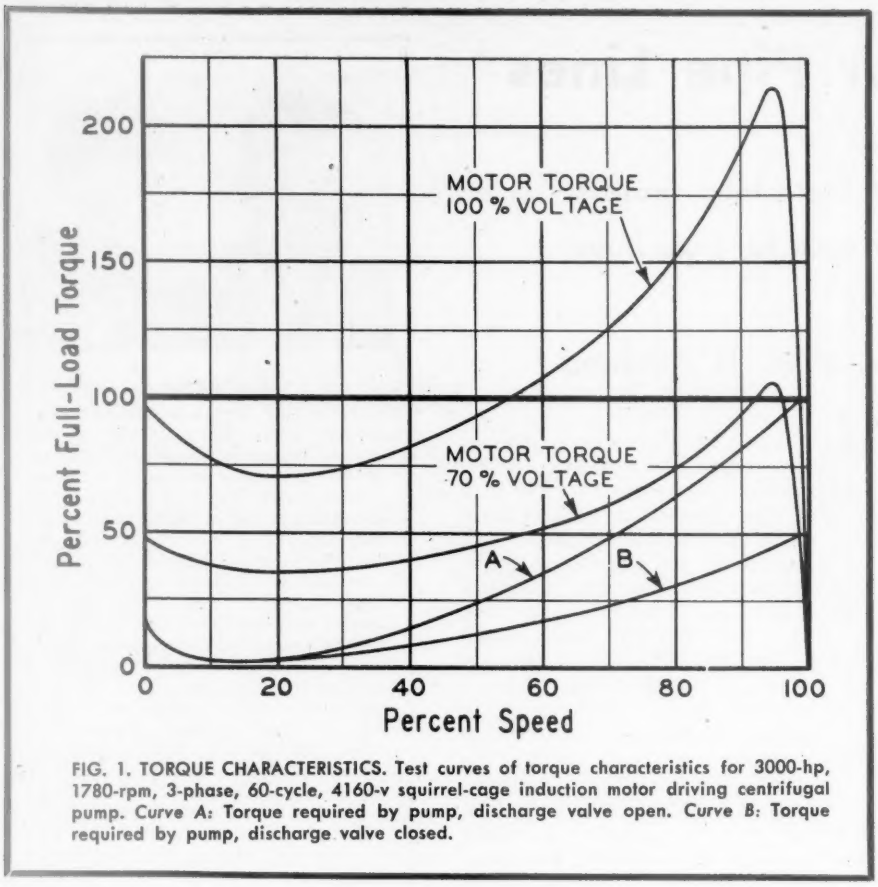


FIG. 1. TORQUE CHARACTERISTICS. Test curves of torque characteristics for 3000-hp, 1780-rpm, 3-phase, 60-cycle, 4160-v squirrel-cage induction motor driving centrifugal pump. *Curve A:* Torque required by pump, discharge valve open. *Curve B:* Torque required by pump, discharge valve closed.

resistance under starting conditions helps to determine the starting and accelerating torque, and the rotor loss under load affects the efficiency. There must be sufficient accelerating torque available during the starting period to accelerate the motor and the pump within a reasonable time. Any additional rotor resistance would result in higher running losses at rated load, hence a reduction in efficiency. The cage design represents the most practical proportions to obtain these objectives. The design utilized the skin effect in the rotor bars at start by the proper choice of rotor-bar cross-section without sacrificing any mechanical strength. The cage resistance was divided between the bars and the end rings in a manner that gave an end ring of ample size to permit the best construction electrically and mechanically. Proportions were such as to obtain a low resistance joint between the bars and end-rings with high mechanical strength. The design proportions also avoided any concentration of heating in the cage windings during starting or running conditions. A low running resistance was obtained and a low loss favorable to efficiency was assured.

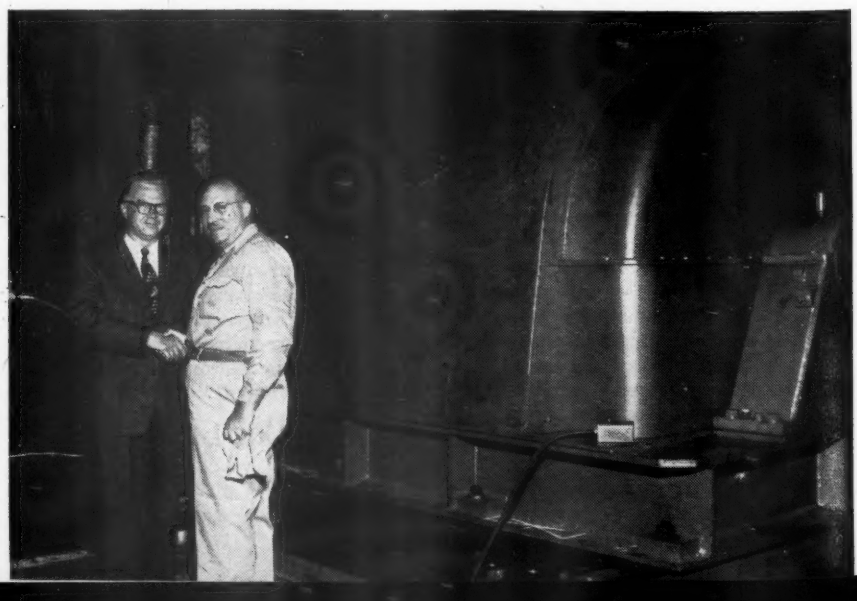
Precautions were taken to keep the stray losses in the stator and rotor to a minimum. The rotor laminations were notched, burr ground, and then coated with a high-grade insulating varnish, which was baked. The outside diameter of the rotor was machined carefully to avoid "burring over" the laminations. The air-gap was made as large as a reasonable power factor would permit to reduce the stray losses and the high-frequency iron losses mentioned previously. To further help achieve these results, a low-loss, non-aging, ductile electrical steel was used in the rotor. This steel also provided high mechanical strength in the rotor teeth. The stray losses in the stator and the eddy current losses in the conductors were kept to a minimum by giving attention to the proper stator coil design.

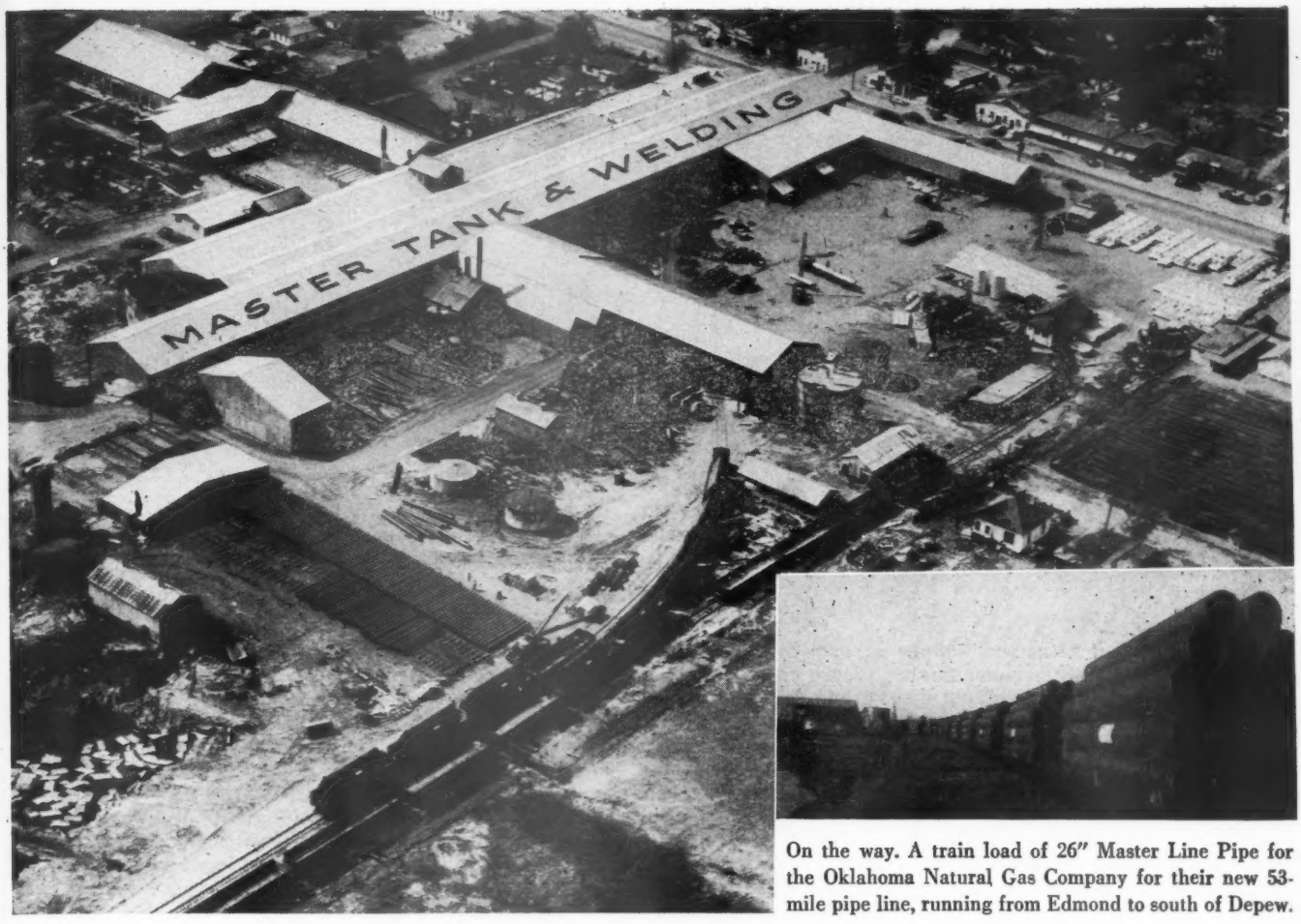
By obtaining low stator and rotor losses, the design permitted some reduction in windage loss because less cooling air than normally required is used. The rotor is aided by the forced ventilation system in supplying the cooling air required at a minimum of loss. The smooth exterior design of the rotor materially aids in achieving a low windage loss.

So far not much has been said about the power factor of the motor. To the observer there appears to be only one stator current flowing into the motor. This current is the vector sum of the current which is "out-of-phase" with the voltage (power component), and the current which is "out-of-phase" with the voltage (reactive component). The ratio of the power component divided by the observed stator current is the power factor, also defined as the cosine of the angle by which the current lags the voltage. The power component depends upon the load and the efficiency at that load. The reactive component for all practical purposes is the sum of the magnetizing current and a current that depends upon the leakage reactance in the motor. The leakage reactance for a given frequency is determined by the number of effective series conductors in the windings, the length of the core, the number of stator and rotor slots, the design of the slots, and the end-turn portions of the stator and rotor windings. As pointed out previously, the value of the reactance is set by the starting current and maximum torque limitations. This in effect fixes the value of reactive current due to reactance and with the power component of the stator current being fixed by the load and associated efficiency under consideration, the power factor is affected only by the value of magnetizing current. To obtain as low a magnetizing current as possible, the effective air-gap and the flux densities were held to otherwise acceptable minimums. In this connection it will be noted that the electrical steel must have a favorable permeability if a high power factor is to be achieved.

The best combination of the foregoing factors of the 3000-hp motors gave a motor having efficiency and power factor values above normal, and a breakdown torque in excess of that specified. The locked rotor current was lower than normal and approximately 100 per cent starting torque was obtained. The accompanying torque curves (Fig. 1)

Making an official test of one of the large motors.





On the way. A train load of 26" Master Line Pipe for the Oklahoma Natural Gas Company for their new 53-mile pipe line, running from Edmond to south of Depew.

36 ACRES of Line Pipe Production

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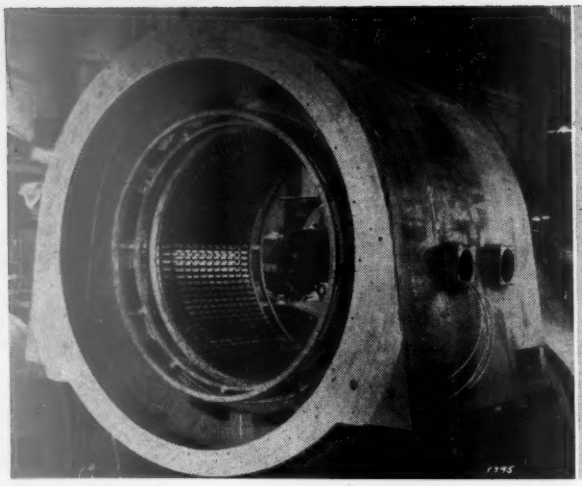
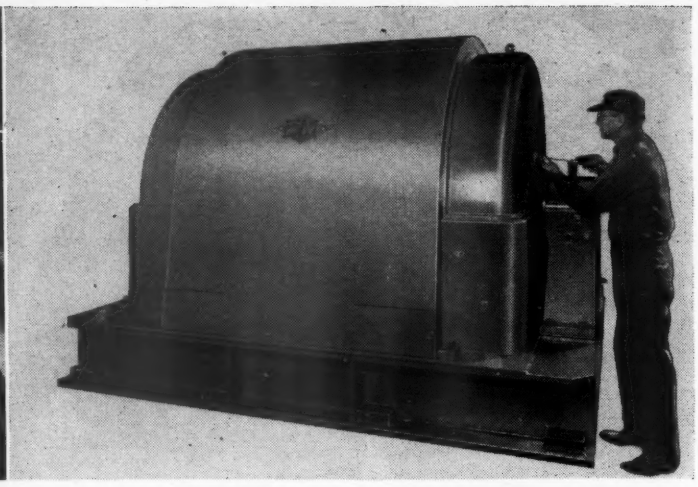


This 3000-hp 1780-rpm heavy-duty squirrel-cage motor is one of 8 being installed on Basin System.



The stator core is anchored in a fabricated steel frame built up of thick section circular steel plates, reinforced with crossribs completely welded to a heavy outside steel backplate.

show that with an estimated voltage drop of 30 per cent (at the motor terminals) existing, and with the pump discharge closed, the motor develops ample torque to bring the unit up to speed in less than 25 sec. With one motor running under rated load, and if an estimated 30 per cent voltage drop occurs when the second motor is started, the first motor will still carry its load satisfactorily.

Mechanical Design

To meet the specifications of the pipe line engineers for larger motors than previously used, together with the vital need for continuous motor performance, meant critical design for dependability in the motors for each specific operating characteristic. The stator, the rotor, and the bearing parts are integrated into a modern, enclosed unit, with each element coordinated to help insure the dependable service.

The stator composes the outer stationary member and consists of the supporting frame, the stator magnetic core, and the stator winding. The frame that supports and encloses the stator core and winding is of "box-type" construction, designed to withstand handling stresses and the magnetic forces between the rotor and stator. The frame is fabricated from multiple heavy steel plates, cross-ribs and a continuous external wrapper plate, all welded together to form a rigid structure.

The ribs that support the stator core are machined to a true circular bore after which the dovetail keys, upon which the core laminations are stacked, are fastened to the ribs by screws and dowels.

The stator core is built up of overlapping laminations, and is clamped between rings that are welded into the frame while the core is under uniform hydraulic pressure. This gives a "locked-in" core without, however, the core being called upon to be part of the frame supporting structure. The clamping pressure is calculated to give a compact core but to avoid too heavy pressure that might cause excessive core loss by breaking down inter-laminary resistance.

The stator coils are insulated with glass and mica tape and are vacuum-impregnated to seal against moisture. In addition, the exterior of the coils is coated to a smooth finish with a moisture resisting enamel. The coil-ends are braced by being lashed to two rings, which are anchored to the frame. This lashing with glass cord at six points on the coil-ends minimizes any possibility of distortion due to the full-voltage starting.

The rotor, which is the mechanical heart of the motor, offers the greatest challenge to the mechanical designer. Special effort is focused toward eliminating sources of "heart trouble," to get a low noise level, and to achieve continuous vibration-free service.

Fundamentally, from the standpoint of noise, the rotor-stator combination would be a siren designer's delight, but is a motor designer's headache. Considering that the surface of the rotor is traveling at a speed of nearly 190 miles per hour, around a track less than 3 ft in diameter, and that air at high velocity is thrown from the rotor vents to impinge upon, and ventilate the stator, special effort is required to design a motor whose noise level is within acceptable limits. Design features include staggered vent arrangement between rotor and stator, recessed vent spacers, deep slot stator coils, and an air throttle. A specially designed retainer ring encloses the complete cage structure at the ends of the rotor to prevent a noise source.

Not only must the motor have a low noise level, but it must have a non-varying low vibration level. Constant minimum vibration is achieved through the elimination of conditions that would cause changes in rotor balance due to shifting of component parts in service, or to effects of temperature variation.

The rotor laminations are designed to contact the rotor spider during all operating conditions, with compensations made for centrifugal and temperature expansion by providing an interference fit between the laminations and the spider. The spider itself has a press fit on the large heavy-duty shaft and is keyed to the shaft. The shaft is proportioned to withstand magnetic pull and also to provide a liberal margin between the operation speed and the critical speed.

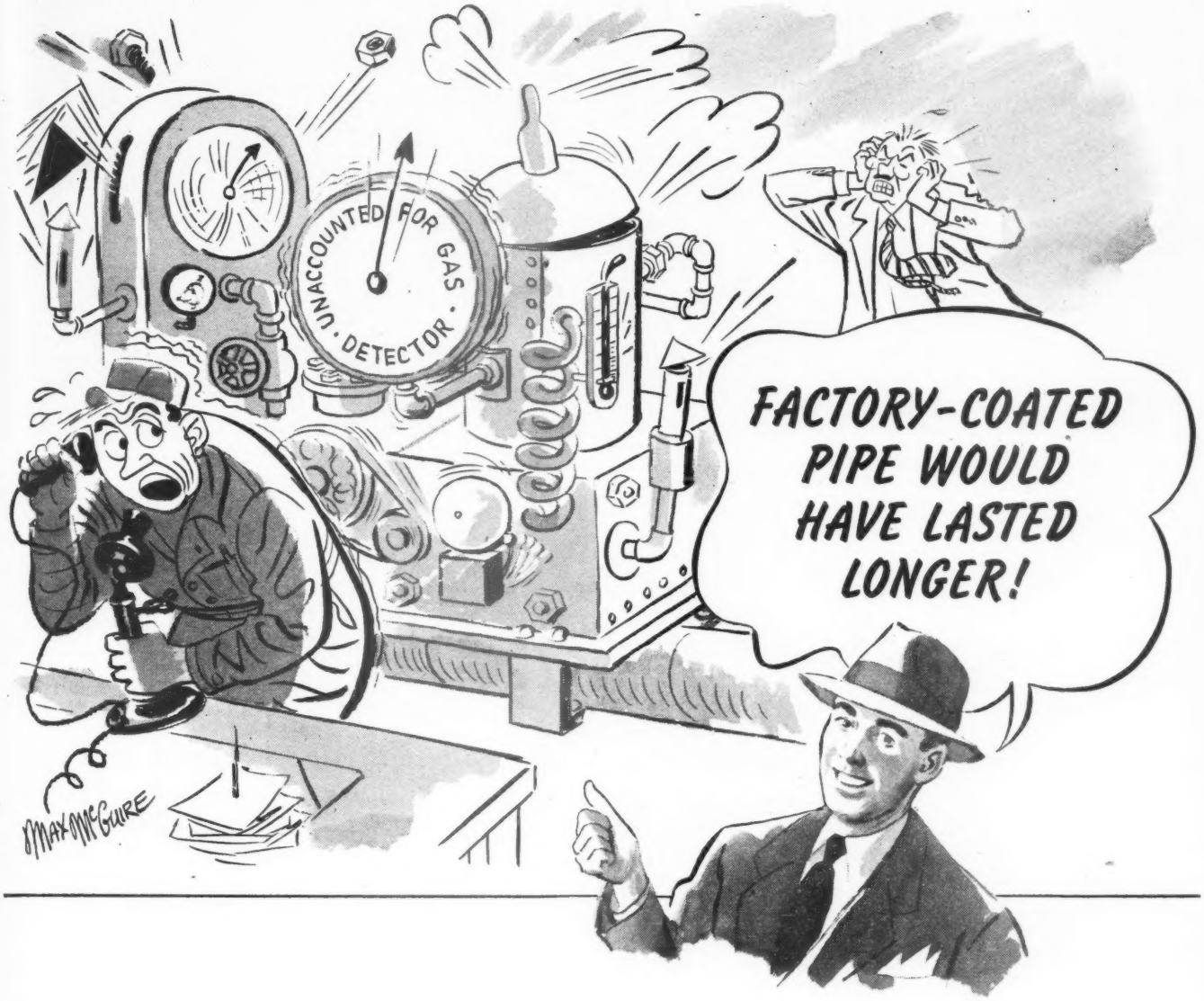
The cage assembly, which consists of a short circuiting ring silver-brazed to the ends of the rotor bars is supported against centrifugal forces by a non-magnetic cage retainer. The cage retainer is in turn permanently centered on the spider to prevent any movement of the cage.

To insure permanence of balance in addition to the design features mentioned, each rotor receives an overspeed run while heated to a temperature above normal operating temperature. A final precision balance run is then made at operating speed to bring the final permanent balance to a value better than commercially accepted limits.

Trouble-free operation is also dependent in a large measure upon trouble-free bearings. The bearings have been specially designed to withstand high journal speeds. The bearing shells are microscopically cleaned by a hot-dip electrolytic etching process preparatory to tinning and centrifugal casting with highest grade tin content babbitt. In addition to a constant flooding of oil from a motor-driven oil pump an oil ring is provided to insure emergency lubrication if failure should occur in the external oil supply. The bearing journals are highly polished by "superfinish" to give lowest possible friction and wear.

The bearings are supported in heavy, welded pedestals which give direct support between the rotor and foundation. By means of shims under the pedestals, the air-gap between rotor and stator can be accurately set and maintained.

* * *



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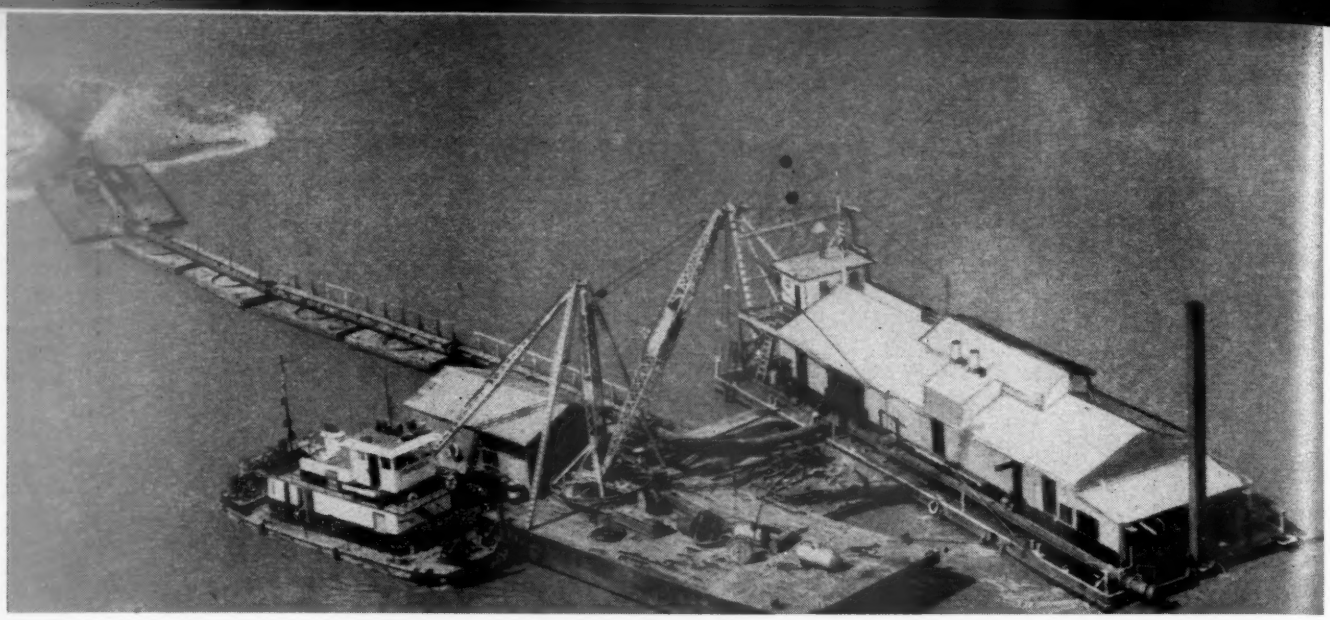

The *Arkansas* lowering crossing No. 1 to sea level elevation after the re-laying operation.

P 615.91

BROKEN RIVER LINE SALVAGED

Methods used by Mid-Valley to salvage, repair, and improve Mississippi crossing point up several factors worthy of thought

JOHN MONTFORT*

DURING the period of high water in the spring of 1951 one of the two Mid-Valley Pipeline Company's Mississippi River crossings failed. A fathometer survey indicated that the bottom of the river had been substantially lowered by scouring. This article describes the salvaging of the two deeply buried broken crossings and the lowering of both crossings to a greater depth than originally installed.

Crossing No. 3, which is shown in Fig. 1, was completed immediately prior to the work described here as a prerequisite for taking the No. 2 crossing out of service.

Essentially the work consisted of uncovering the lines in the east bank, cutting the lines at the east overbends, removing the section of the broken line between the break and the overbend, attaching cables to the end of the section that was to remain, lifting the end above water, relaying to the overbend, and lowering both lines by sandsucking.

It is hoped that this article can convey three things: (1) That salvage of large diameter pipe line river crossings is feasible even in deep water where the line is buried well below the bottom; (2) that lowering a pipe line through sand by sandsucking is often quite feasible, and (3), that a combination utilizing a cutter dredge to remove some overburden with a sandsucker to lower the line to finish grade would in many cases be the most economical manner to lay a new line that was to have substantial cover.

Crossings No. 1 and 2 are examples of lines that were originally laid in deep water at a substantial depth below the river bottom. Salvage operations disclosed that the break occurred at Station 18+60, which is about 400 ft from the east bank. It will be noted in Fig. 2 that the east approach of crossings 1 and 2 was quite deep. As required by the U. S. Engineers, the substantial approach cut had been backfilled following the original laying of the crossings. While work was progressing on crossing No. 3 scrapers and a large dragline were put to work removing as much of this east approach overburden as possible. This work could be done safely with respect to the operating No. 2 crossing because the pipe was so much below the elevation of the excavating scrape. When the No. 3 line was nearly complete a 20-in. cutter dredge was set in to complete the uncovering of crossings 1 and 2 in the approach. Because the material was recent backfill, the dredge was employed without its cutter, that is to say, it was used as a sand sucker. The dredge had an extremely heavy ladder, which had been lengthened especially for this job to permit cutting to depths 75 ft below water. The dredge was very insensitive because of the heavy ladder and it was decided that it would not be wise to have the ladder strike the pipe because it might damage it. For this reason the dredge uncovered crossings 1 and 2 to an elevation approximately 6 ft above the pipe.

An air compressor having a capacity of 310 cu ft per min was installed at the west end of the crossing to pump air through the break for location purposes. The escaping air marked the location of the break very noticeably and to everyone's surprise the compressed air carried past the break and was delivered at the east end of the crossing. This indicated either that the pipe was merely cracked or that the broken ends were well aligned.

Line No. 1 was sawed just west of the overbend, after which a sandsucker set in at the east extremity of the approach cut and began sucking the remaining covering off the line. The sandsucker had a 20-in. pipe ladder more than 100 ft long and could suck at depths 85 ft below the water surface. The pipe ladder was relatively fragile, the boat itself was of medium size. The two factors combined to make the equipment sensitive for work around a pipe line. It was easy to tell when the ladder had struck

*Staff Assistant, Mid-Valley Pipeline Company.

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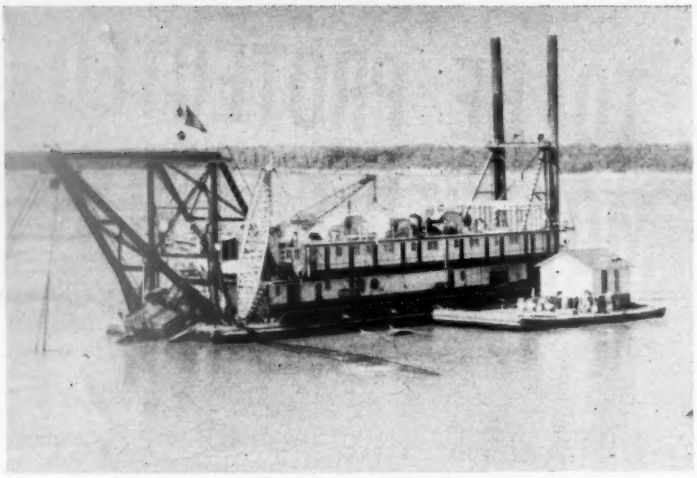
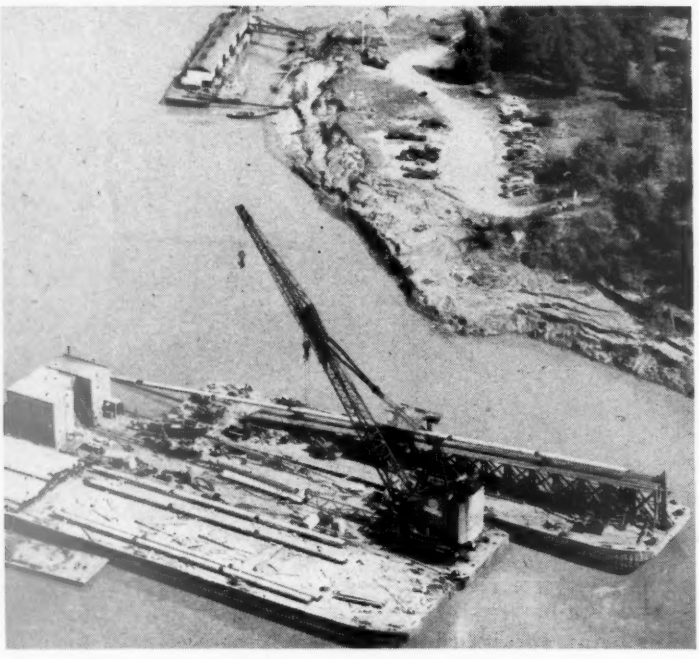


Dredge *Port Arthur* uncovered lines in east bank approach.



Ramp barge, derrick barge, and pipe barge re-laying crossing No. 1 from the break into the east approach.

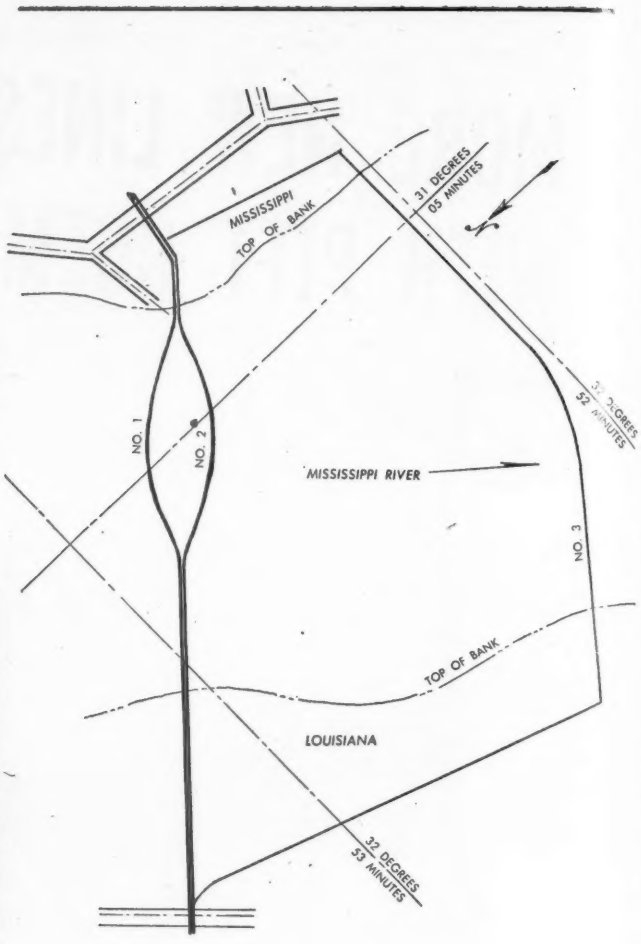


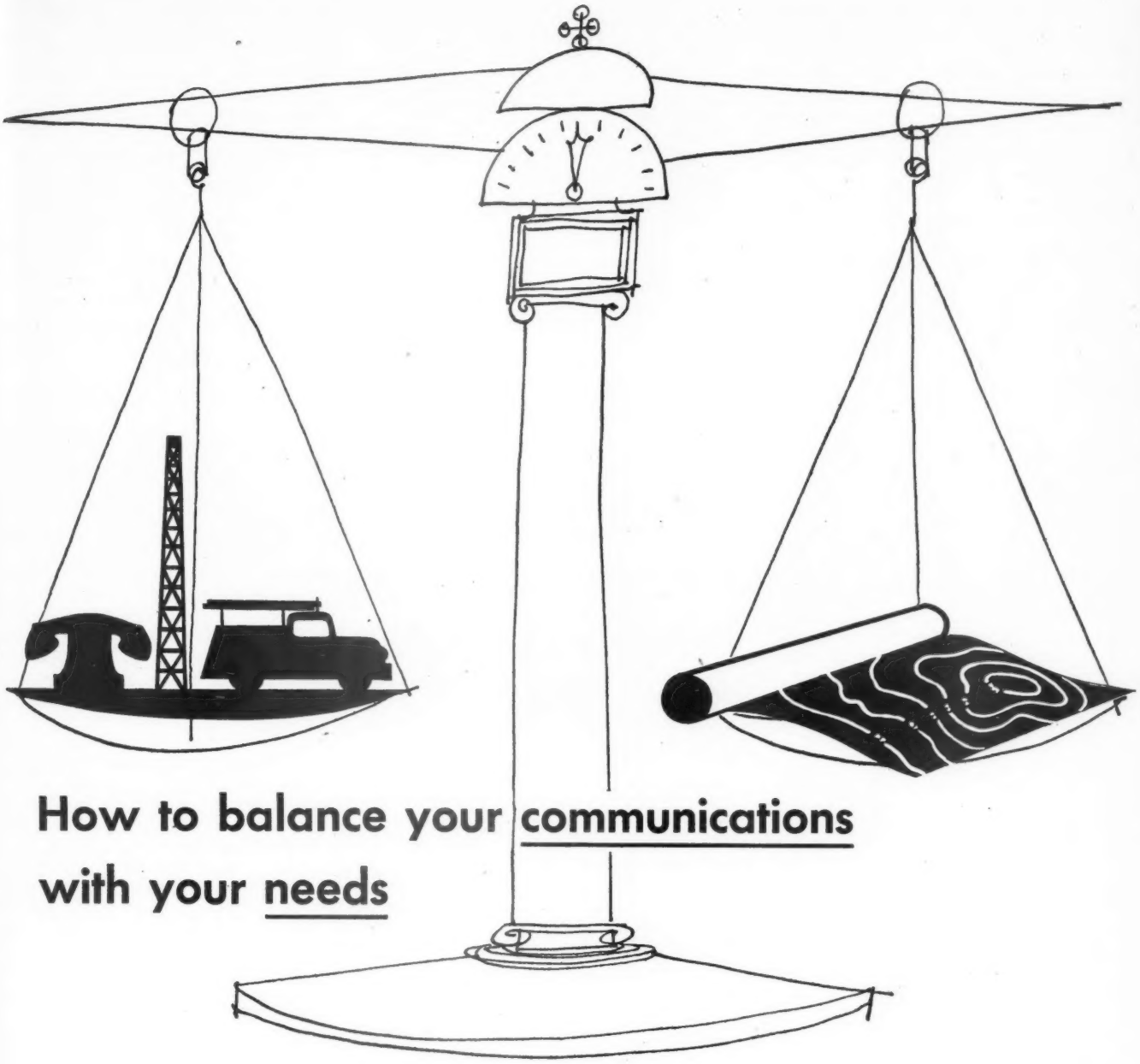
FIG. 1.

the pipe line either from the top, the bottom, or the side. With this light ladder there was no danger of damaging the pipe.

After the sandsucker had swept about 400 ft of the pipe west of the cut, a 75-ton capacity derrick barge was brought into the cut, and an especially made dual roller cradle was slipped over the pipe end and attached to the load line of the derrick. As the derrick lifted the pipe the derrick barge winched itself toward the river, which caused the line to be progressively picked up from the bottom. After this procedure had continued for about 200 ft a ramp barge was set in and the end of the pipe placed on the ramp. It was hoped the break section would possess sufficient mechanical strength to hold together and serve to lift the necessary amount of line west of the break; however, it did not. The situation then was that the section of line from Station 10+50 to Station 18+60 was removed and the broken end of the west section was lying beneath the river bottom with no lines attached.

At that point the sandsucker set in and swept the line clean for approximately 400 ft west of the break. It then set in about 25 ft from the broken end, placed its suction against the line, pumped for about 30 min to create a hole under the pipe, after which it shut down leaving the ladder against the pipe. A diver, operating with only a face mask and bathing trunks, took the end of a $\frac{3}{8}$-in. cable down and around the pipe. The current here was extremely swift and it was necessary that the ladder of the sandsucker be available for him to climb down. After placing the $\frac{3}{8}$-in. cable around the pipe the diver brought the end back to the surface to complete a $\frac{3}{8}$-in. cable sling. At that point men working above water attached a $\frac{7}{8}$-in. cable to one end of the $\frac{3}{8}$-in. sling and replaced the $\frac{3}{8}$-in. sling with a $\frac{7}{8}$-in. sling. The sandsucker and the diver repeated this operation at three other points to provide four $\frac{7}{8}$-in. lift slings spaced approximately 75 ft apart. The elevation of the water surface during this operation was approximately 85 ft mean sea level. The elevation of the pipe had been inadvertently lowered by uncovering operations to an approximate elevation of 15 ft msl.

After the four lift lines were attached the derrick was hooked up to the endmost sling and three support or winch barges were attached to the remaining three. Using welder's crayon, large scales were marked on the decks of the support barges, so that by watching the movement of the cable blocks it was possible to tell how much the pipe had been lifted. A fathometer boat equipped with a precision supersonic fathometer was stationed west of the westmost barge and moored so that its fathometer hovered above the pipe. The four pieces of lift equipment began lifting more or less simultaneously with the contractor's superintendent and the company's inspector agreeing on the respective amounts of lift for each piece of equipment to provide the proper vertical curvature. Meanwhile the hovering fathometer indicated that the pipe was lifting evenly from the bottom rather than



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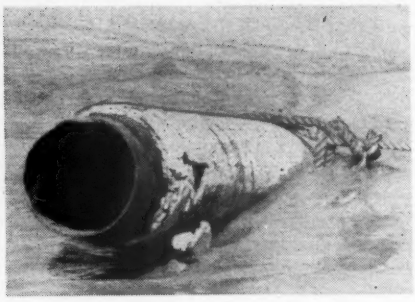
buckling at one place. This procedure continued until the end of the line was lifted above the water. It was lifted far enough above the water that the end could be placed on the ramp of the ramp barge and one 40 ft joint removed. These lines have a negative bouyancy in fresh water of only 18 per cent when empty. It was therefore desirable to displace the water from the west section of line No. 1 before lifting the broken end above water.

Three air compressors of aggregate 700 cfm capacity were installed at the west end of the crossing and operated for 24 hours ahead of pick-up and during pick-up. There was a cyclic effect wherein no air bubbles appeared on the water for periods of 15 to 20 min and then suddenly ebullition would take place throwing water 10 to 12 ft in the air for a period of several minutes. The lifting was synchronized with these periods of ebullition, for it was felt that the water was almost completely displaced at those times. The line handled in a manner that indicated it was reasonably empty.

Two pre-fabricated 120 ft long sections were then welded on and laid from the ramp barge to bring the end of the line to a point close to the bank. The end was capped and a 4-in., 50 ft long riser was attached. The line was then lowered to a point where the end was about 10 ft off the bottom so that it would not be subjected to vibrations from the current. Four load lines had been attached and were buoyed off. A 1000-psi hydrostatic test was applied through the 4-in. riser to prove that the part of the crossing that was to remain was in good condition.

The cutter dredge, with its cutter attached, then set in at the east bank approach north of the No. 2 river crossing and began cutting the approach to the improved finish grade. Because of its



Broken end of crossing No. 1 raised from the muddy Mississippi.

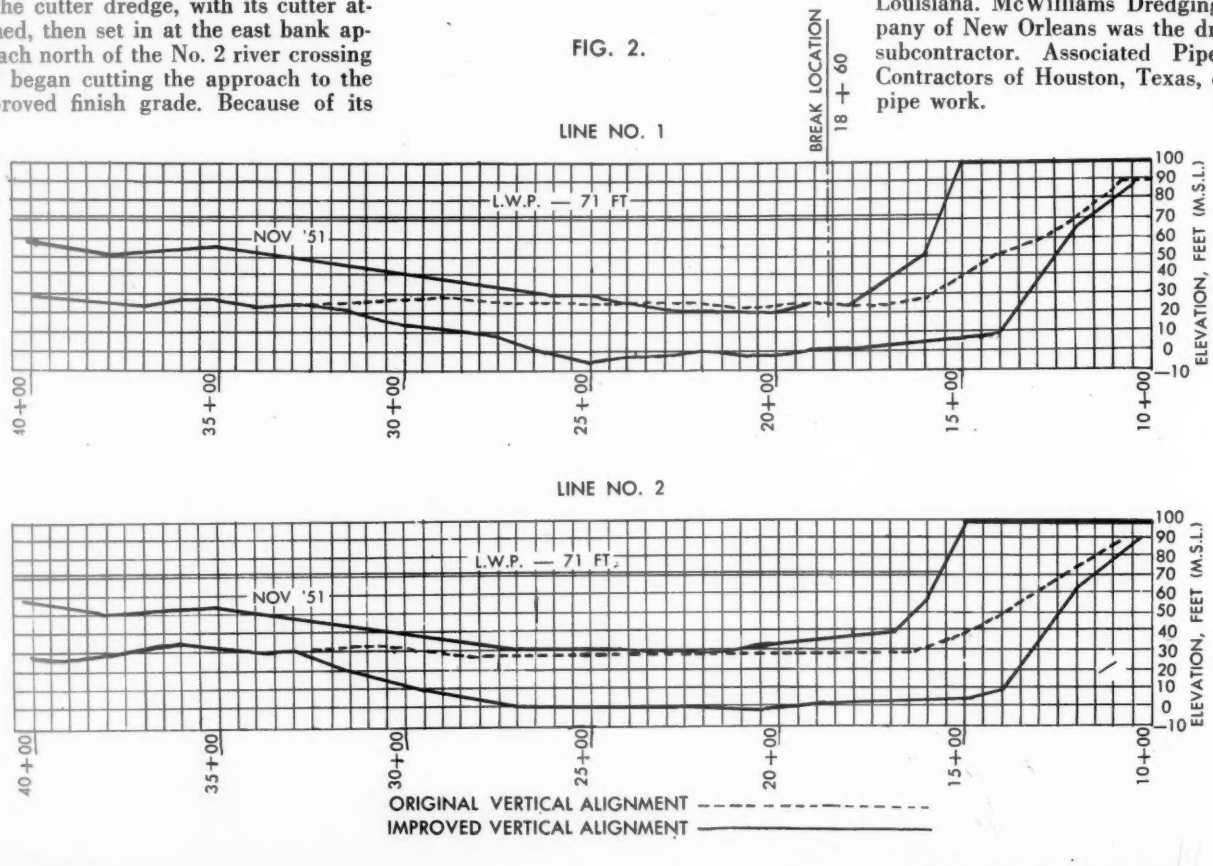
proximity to crossing No. 2 the soil beneath the crossing sloughed to the dredge suction requiring that No. 2 line be supported at several points off the side of a 250 ft barge. It was not possible for the dredge to make and hold the approach ditch to the finish grade because of the extremely high banks; however, what sloughed in was loose material. As soon as the dredge had cut out the approach, crossing No. 1 was picked up the second time, placed upon the ramp barge and laid out to the overbend. The sandsucker then set in at the overbend and by sucking alongside the pipe lowered the pipe to the improved vertical alignment indicated in Fig. 2. Upon completion of line No. 1 the same lowering process was repeated for line No. 2.

Lowering a pipe line with a sandsucker is a most effective method. It is necessary to have a sandsucker with sufficient capacity that it can make good headway, for it is necessary to make something over 100 ft of ditch before big pipe will sag down. It is helpful to increase the negative bouyancy of the line by having it full of liquid. It was found possible to lower the line as much as 30 ft at one drop but progress was faster when two passes were made, each dropping the line 15 ft.

The sandsucker used here had a capacity of 15,000 to 20,000 cu yd of solids per day. In a case like this there probably is no choice to be made between sucking down the line with a sandsucker as compared to cutting a finished ditch with a cutter dredge and laying the line in the finished ditch, because in this case it would have been impossible to have held a ditch open that had been made days ahead of time unless it was of exorbitant width. When the finished ditch is dredged ahead of time, depending upon the size of the dredge and the requirements as influenced by the river current, it is customary to cut a ditch on the order of 100 ft wide at the bottom. With the sand assuming angles of repose of 1 on 3 and 1 on 4, it is apparent that cutting a ditch ahead of time involves the movement of many times more yards of sand than is required in a sandsucking operation. Cutting the ditch ahead of time, however, has the advantage that the pipe can be placed accurately both horizontally and vertically and there is no danger of damaging the line.

The success of this job, the major part of which was done in eight weeks including backfill, is attributed to the adequate dredging and marine equipment used combined with the sure skill of men who are at home on the river. The prime contractor was J. Ray McDermott and Company of Harvey, Louisiana. McWilliams Dredging Company of New Orleans was the dredging subcontractor. Associated Pipe Line Contractors of Houston, Texas, did the pipe work. * * *

FIG. 2.



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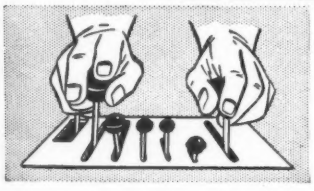

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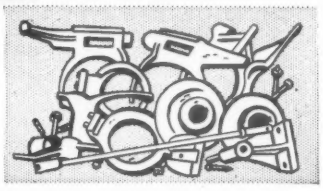

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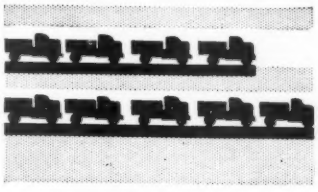

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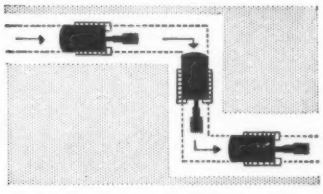

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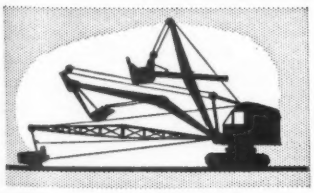

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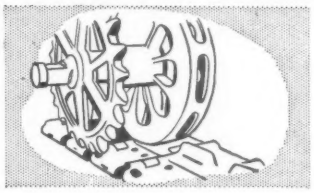

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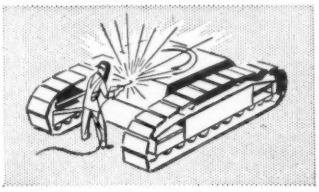

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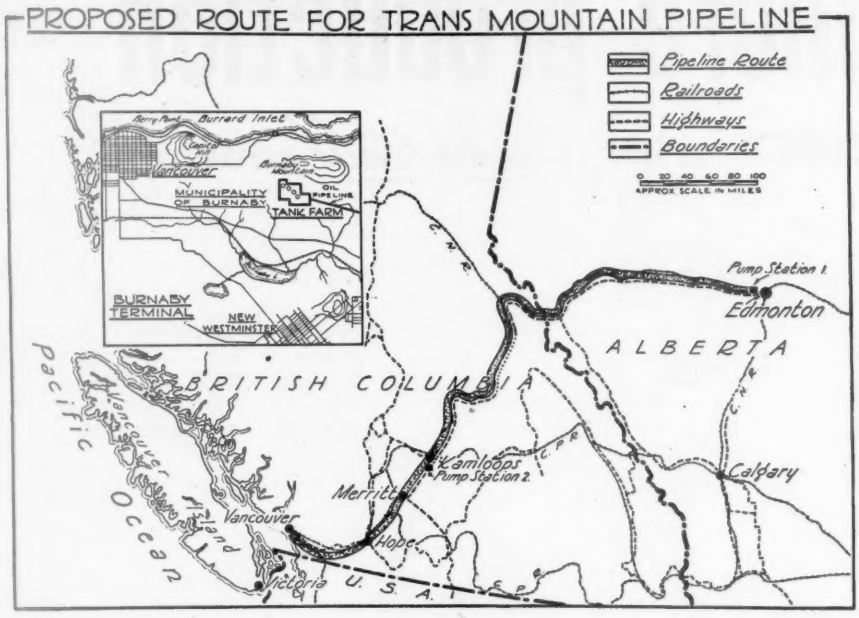

EXCLUSIVE

Trans-Mountain Pipe Line Will be $80,000,000 Project

HARRY CHAPIN PLUMMER

FOLLOWING official grant by the Board of Transport Commissioners for Canada of the Trans-Mountain Oil Pipe Line Company's application to build a 695-mile, 24-in. line from the immediate vicinity of Edmonton, Alberta, to Burnaby, British Columbia, adjacent to Vancouver, announcement has been made that Canadian Bechtel Company, a subsidiary of Bechtel Corporation, will design and supervise construction. The capital investment, placed at $80,000,000 by the company's engineers, is based upon material, freight, and labor costs as of November of last year and includes a provision of $6,000,000 for contingencies.

The pipe line will have an average daily capacity of 75,000 bbl, and this can be increased to 200,000 bbl by the addition of three pumping stations to those initially planned for sites—one at the starting point, near Edmonton, the other on the outskirts of Kamloops, British Columbia, about 410 miles southwest on the route to the tidewater terminus and by increasing the initial storage of 1,095,000 bbl.

The pipe line generally will parallel the Canadian National Railways tracks from Edmonton, through the national Jasper Park, over Yellowhead Pass, to Kamloops, thence to Merritt, British Columbia, whence the Canadian Pacific Railway line will be followed to Hope, British Columbia, and from that point extends alongside the course of the Fraser River to Burnaby, where storage facilities will be erected. The proposed route has been covered by detailed reconnaissance surveys, both aerial and ground, and the location has been definitely fixed.

By the time the pipe line is placed in operation, now scheduled for early 1954, refineries in the Vancouver area, according to present plans of their operators, will have a potential demand for 37,500 bbl per day of Alberta crude petroleum. In order to handle more Alberta crude petroleum than required for the existing Vancouver demand it would be necessary to provide a loading line from Burnaby to nearby Burrard Inlet, where deep water transportation would be made available, thus opening up potential Pacific Northwest U. S. markets, both land and off-shore, now supplied in large measure from California. An additional estimated capital cost of $17,500,000 would provide for the three additional pumping stations, increase of the initial 375,000-bbl storage accommodations at Edmonton and 720,000-bbl facilities near Burnaby, and the loading line to Burrard Inlet.

It is the present intention of the company to establish a pipe line tariff of approximately 60 cents per barrel at the initial estimated throughput of 37,500 bbl per day in 1954. Based on the relative prices prevailing today, it is estimated that that proposed figure would enable Alberta crude oil to compete successfully with California crude at Vancouver without change in the wellhead price in Alberta.

Apart from British Columbia, the only refinery capacity in the Pacific Northwest consists of one refinery at Spokane, Washington, and two asphalt plants at Portland, Oregon, and Seattle. The former has a daily capacity of approximately 5000 bbl, the latter two a combined daily intake of 7000 bbl of heavy crude oil; but should a sufficient export market for crude be developed in the Pacific Northwest states, as a result of new refinery construction, it is expected that the Trans-Mountain Pipe Line, by operating at higher throughputs, would be able to reduce the pipe line tariff to an extent that, in appreciable measure, would offset the additional transportation costs, U. S. import, taxes and other charges that would be incurred in shipping Alberta crude across the border.

Underwriting of the project has been obtained by first mortgage and collateral trust bond issues totaling $65,000,000 (Canadian) and capital stock $14,025,000 (Canadian) and "deficiency agreements" guaranteed separately for each stage of capital expenditure by Canadian Gulf Oil Company, Imperial Oil, Ltd., Richfield Oil Corporation, Shell Oil Company of Canada, Ltd., Standard Oil Company of British Columbia, Ltd., and the Union Oil Company of California, under execution by the Trans-Mountain Oil Pipe Line Company and the Montreal Trust Company, as trustee.

The officers of the company are: Stephen Davison Bechtel, Oakland, California, chairman of the board; Robert Lysle Bridges, Lafayette, California, president; Sidney Martin Blair and Michael Lawrence Haider, respectively, Bolton and Toronto, Ontario, vice presidents; Ian Grant Wahn, secretary and assistant treasurer, Toronto, and Joseph Merrick Tescher, Palo Alto, California, treasurer and assistant secretary.

Mannix, Ltd., of Calgary, will lay approximately 221 miles in the center of the line, and Comstock Midwestern, Ltd., of Toronto, will construct approximately 472 miles on the eastern and western ends of the line. * * *

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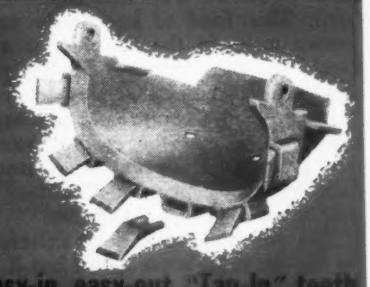

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Steam Turbo-Compressor Stations

The selection of a driver for centrifugal gas compressors for pipe line transmission systems

H. LEE NORRIS, JR.*

It was pointed out in the previous two parts of this article that a centrifugal compressor inherently is a very simple device. Its flexibility is dependent for a given application on the speed of rotation and its characteristic curve. The selection of a driver for a centrifugal compressor amounts to the selection of a machine that can deliver sufficient torque at a sufficient speed range so that the optimum overall characteristics of the driver and the compressor may be realized.

Whether the driver is a steam turbine, gas turbine, reciprocating engine through gears, or electric motor is primarily a question of economics for a given installation. By and large, the final criterion on the selection of a means of compressing gas is the total cost per unit of gas pumped. Other factors are in the minor category. Dependability is a matter of designing the driver and its auxiliaries to be dependable. If the cost of such a dependable station runs up the cost of pumping gas, then other means of pumping this gas should be examined.

The engineering profession has available a vast fund of knowledge, going back to James Watt and his steam engine. This fund of knowledge can be drawn upon in the solution of a particular problem to the end that almost any characteristics that may reasonably be desired in a compressor station may be designed and the cost of pumping gas determined approximately from design and experience considerations without doing actual construction.

The selection of various drivers will be discussed in some detail but it must be borne in mind that no type of driver is the best under all conditions. An evaluation must be made of various types of drivers to fit each compressor station application.

First, consider the electric motor drive. To drive a centrifugal compressor, the characteristics of a squirrel-cage induction motor are such that it makes a satisfactory driver for any given horsepower rating. The squirrel-cage induction motor is the cheapest electric motor available. High starting torque is not required. The induction motor may be an open type and the compressor room and motor room separated with a partition wall or the motor may be explosion-proof and the partition wall eliminated. There probably would not be a very great hazard involved in running an open squirrel-cage motor in the same room with a centrifugal compressor but this practice in all probability would be frowned upon by the underwriters. The labor cost for a compressor station, using induction motors, is low and the possibility of having a completely automatic compressor station with no attendants is quite attractive. Instrumentation and communication are available to permit motor-driven centrifugal compressors to be operated under remote control or under automatic local control.

The major factor in the selection of a motor-driven centrifugal station, of course, is the cost of purchased power. This item varies widely in different parts of the country, depending upon the basic rates of the power system involved and the capital cost necessary to connect this motor load to the system.

Of course, as pointed out earlier, the most severe limitation on using induction motor drivers is the loss of flexibility due to constant speed operation. The load, from the point of view of a power company, probably would be most desirable, as its fluctuations are of minor order.

The use of synchronous motors probably would not be justified due to the inherent high power factor of an induction motor when fully loaded. Using a multiplicity of single stage compressors, if driven by induction motors, allows the load variation to be taken in steps of one motor, which keeps the running motors operating at high power factor.

Power factor approaching unity or even leading power factor can be obtained by the use of capacitors at a lower total cost than by the use of synchronous motors. An induction motor station would make a very excellent "peak knocker" if suitable arrangements can be made with the power supplier concerning demand charges. If the usual demand charges must be borne the induction motor driver is not attractive as a "peak knocker".

The use of a gas engine, diesel engine, or dual fuel engine has its particular place in the problem of driver selection for centrifugal compressors. In all cases a speed increasing gear is necessary because of the inherently low speed characteristics of a constant duty internal-combustion engine. The most recent techniques of gear design and gear cutting makes available to the designer speed increasing gears that are most dependable and they have a long life.

The internal-combustion engine has the highest thermal efficiency of any prime mover yet developed and, consequently, is attractive for driving centrifugal compressors through step-up gears, particularly where the cost of fuel is high, such as near the end of a long gas transmission line. It is probable that conventional reciprocating - gas - engine compressors are more attractive near the beginning of a long transmission line. The speed range of an internal-combustion engine is satisfactory to give the required flexibility so that the desirable characteristics of a centrifugal compressor, which depend on speed variation, are available when driven through gears by a reciprocating engine.

The reciprocating engine drive would be even more attractive if engines of 5000 hp up were commercially available at this time.

The gas turbine presents a newcomer in the prime mover field and should be most attractive for a centrifugal compressor drive. It is inherently a high speed device and, hence, requires no step-up gears. Its speed is variable over a satisfactory range to permit full advantage to be taken of the flexibility of the centrifugal compressor. It possesses good thermal efficiency. Manufacturers

*Engineer, Fish Engineering Corporation.

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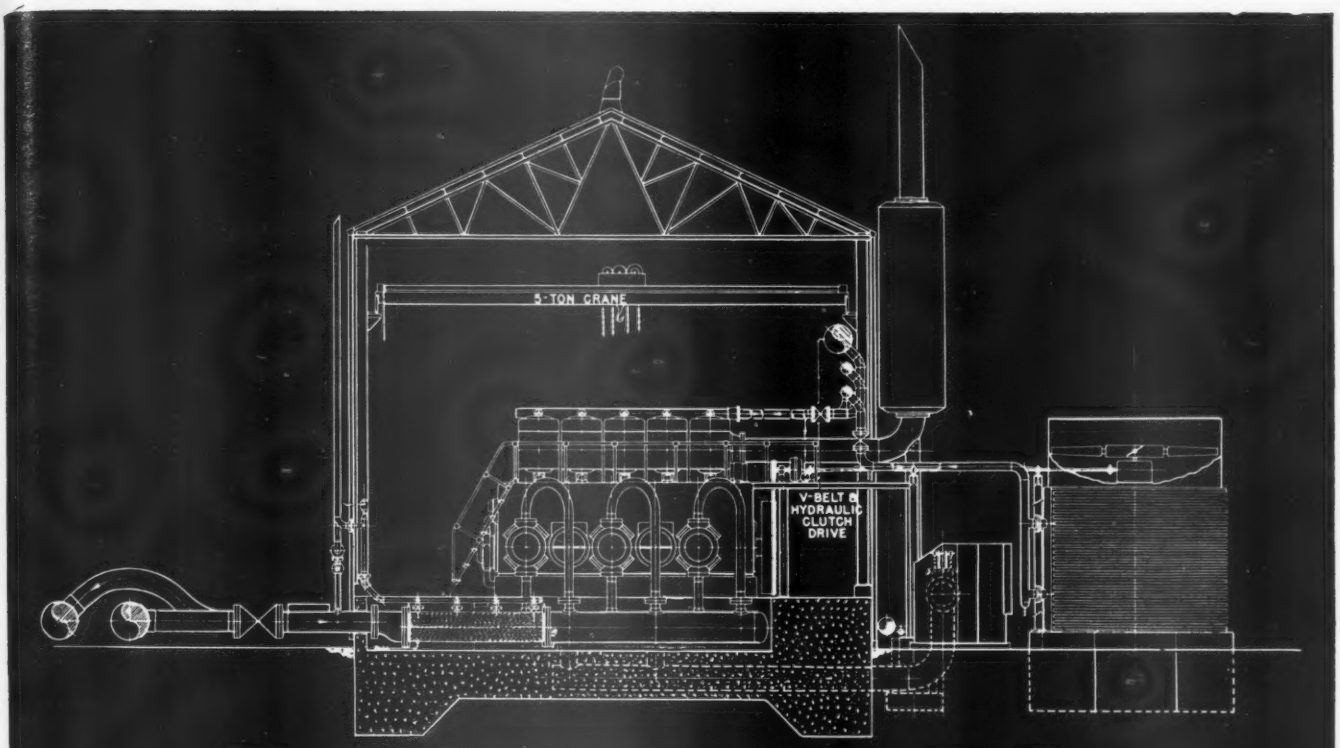

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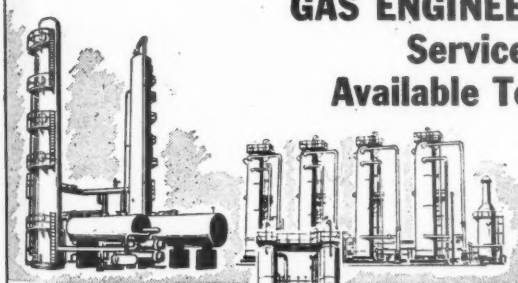

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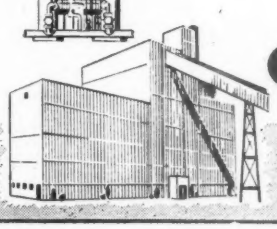

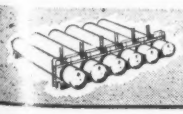

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are now prepared to quote up to 25 per cent thermal efficiency, using the regenerative cycle. It rejects all its waste heat directly to the atmosphere and no cooling water is required except small amounts for lubricating oil cooling. It is readily installed in locations where water is scarce or in cold climates where the freezing problem on cooling towers assumes major importance. It requires a somewhat specialized governing apparatus and also elaborate safeguards to prevent an internal explosion. Manufacturers are now prepared to build gas turbines under the standard machinery warranties.

There have not been a sufficient number of installations of gas turbines to make possible an accurate estimate of their operating reliability and maintenance cost. The gas turbine industry is making rapid strides due to experience gained in aircraft jet engine application and due to the tremendous wealth of engineering knowledge developed over the years in connection with high temperature steam turbines. The temperatures involved in gas turbines are only a little in excess of temperatures that are currently in use in large central stations and many metallurgical developments caused by high steam temperatures have lead to similar developments of metals usable in gas turbines. It is to be borne in mind that the metal parts of a gas turbine subjected to very high temperatures are limited to the first stage. The expansion of the hot gas through the first stage lowers its temperature to the point where it can be handled adequately.

One phase of the application of gas turbines to gas pipe line compressor drives is the scarcity of auxiliary power when the compressors are shut down. The corollary to this is also the requirement of the starting power for the gas turbine, which has to be cranked at approximately 25 per cent rated speed in order to start. Once the unit is running, power take-off for auxiliary and lighting use can be easily made by connecting variable frequency alternating current generators or direct current generators designed for broad speed range.

The gas turbine can be cranked either by an electric motor or by a small turbine expanding pipe line gas and wasting it to the atmosphere. In case the electric motor starter is used, an auxiliary generator set such as a high speed gas engine driving an electric generator is required. In using the starting turbine, a considerable amount of gas from the pipe line is wasted to the atmosphere and there again the choice between these two systems is a question of design economics.

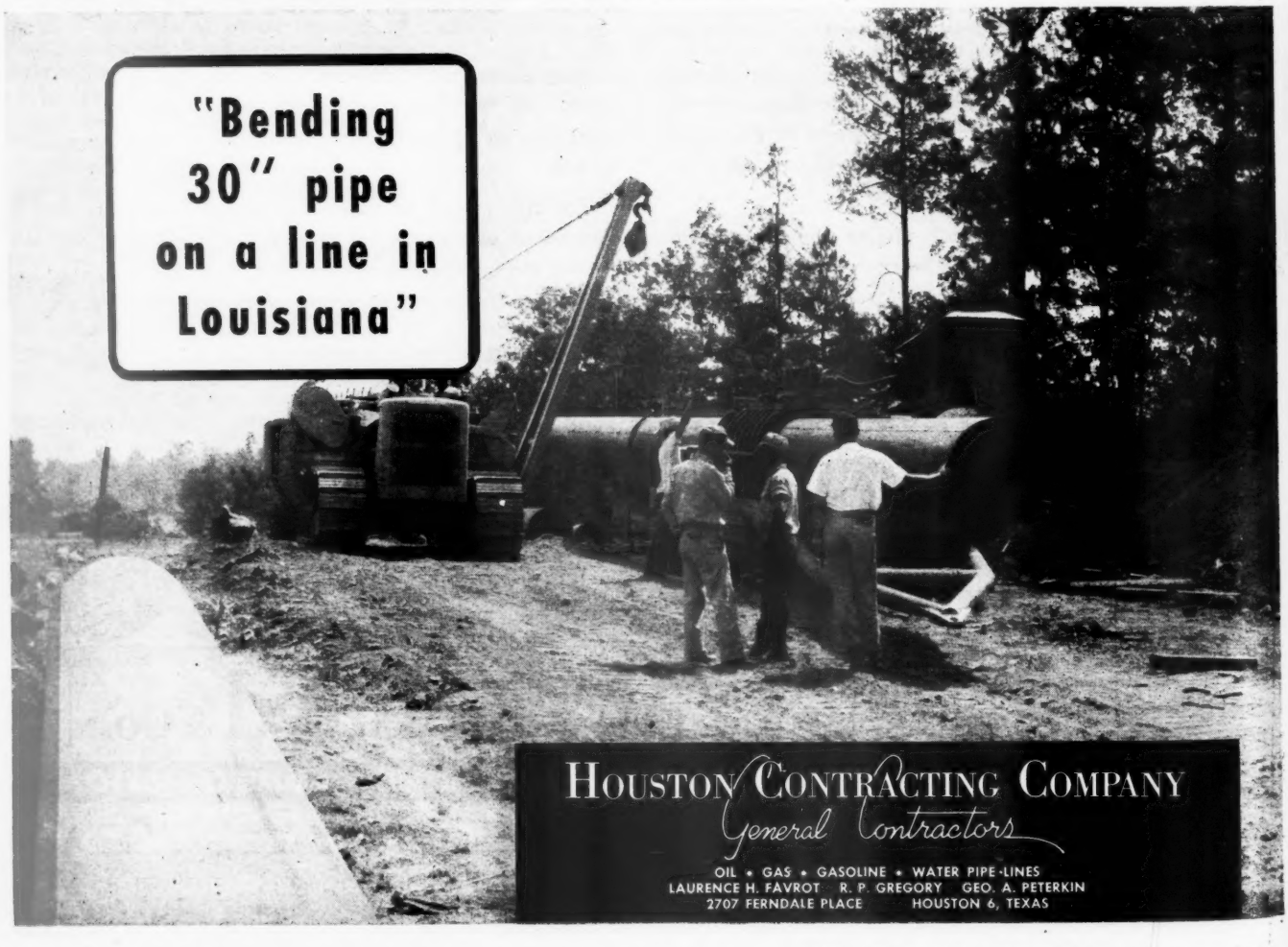
The gas turbine as a prime mover promises a brilliant future and at the present time its use is made questionable only for timid operators who do not choose to take a calculated risk.

Traditionally, the centrifugal blower or compressor has been driven by the steam turbine. As a matter of fact, many of the early centrifugal compressors were developed by the same men and the same concerns that did the early work on steam turbines. The steam turbine is the most universally used prime mover for central station work, and in the larger sizes of recent design, the steam turbine and the boiler supplying it have become the most dependable prime movers ever developed. Some large central stations in the United States have developed amazing dependability records with some steam turbines carrying loads continuously for as much as seven years.

Steam turbines for gas compressor drives must be the condensing type in order that high fuel economies may be realized. The use of a simple steam cycle without the use of regenerative feed water heating allows approximately 23 per cent thermal efficiency to be attained, using 600 psi, 750 F total temperature steam and exhausting to a 2½-in. absolute pressure.

The Transcontinental stations were all designed for 600-750-2.5 and this selection of pressure and temperature was made primarily because 750 F is the maximum steam temperature for which plain carbon steel can be used for pipe, valves, fittings, and turbine casing. The 600 psi pressure was chosen as the highest pressure usable before piping cost, etc., becomes large.

The thermal efficiency of a steam cycle, generally speaking, can be almost as high as one is willing to pay for.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Large utility stations, using high pressure and high temperature, consistently attain thermal efficiencies in the middle 30 per cent, depending, of course, on overall cycle selection and local conditions. To date turbine manufacturers have not developed turbines as small as 5000 hp for steam temperatures above 750 F. This is not because there is an engineering reason for avoiding high pressures and high temperatures but because demand for these turbines has not existed.

It is suggested that a considerable increase in thermal efficiency of the steam turbine driving centrifugal compressors can be achieved if the owners are willing to accept as many as three compressor stages in one compressor casing. In the case of the Transcontinental compressor stations, substantial savings could have been made and increased efficiency obtained had the three nominally 5000-hp compressors been combined into one 15,000-hp compressor driven by a 15,000-hp turbine.

This larger turbine could have made the use of higher pressure and higher temperature attractive and would have made regenerative feed water heating highly attractive. The combination of high pressure, high temperature, and regenerative feed water heating allows the cycle efficiency to be substantially increased to perhaps something approaching 30 per cent.

The selection of a steam cycle requires a very large amount of study and no hard and fast rules can be given for its selection. The procedure for the study in general is to assume some of the more or less standard steam pressure and temperature and regenerative feed water arrangements and then, by trial and error method, derive the total construction and operating costs for the various assumed cases for comparison.

One serious drawback to the use of the steam turbine is the amount of cooling water necessary for the surface condensers. If one is fortunate enough to have a nearby lake or stream as a dependable water supply this problem is solved. It is not too involved if adequate makeup water is available for a cooling tower. Some preliminary studies have been made on air blown extended surface steam condensers. This equipment compares favorably in cost to the cost of surface condensers, pumps, piping, and cooling towers; however, during the hot weather months, the operation of a direct blown air-cooled condenser would be penalized by higher steam consumption of the turbine. In the winter, the reverse would be true. A very high vacuum should be easily attained. The greatest problem perhaps would be the design of a turbine capable of making economical use of the high vacuum.

The amount of water used as makeup in this steam cycle presents no problem whatever. Makeup water of less than 1 per cent of the steam flow is easily achieved and perhaps one-half to one-fourth per cent makeup is not too hard to attain. This makeup water should either be evaporated or passed through an ion exchange demineralizer unit in order to remove any dissolved solids that might cause scaling or corrosion. Proper conditioning of makeup water, the use of mechanical deaerators, supplemented by a small amount of water-treating chemical added directly to the boiler drums will adequately keep boilers free from scaling and corrosion. The science of boiler water chemistry is highly developed and many thousands of boilers are operating all over the country with no difficulties from scaling and corrosion.

The other traditional headache with steam boilers through the years has been slagging and burning out of refractories. A well designed boiler furnace employing water-cooled refractories and burning natural gas fuel should operate for many years, requiring only minor repairs. Many boiler operators are able to keep their boilers steaming continuously from annual inspection to annual inspection and it is with great degree of certainty that modern boiler plants can be installed that will require but one boiler outage per year for the annual boiler inspection as required by state law.

Centrifugal stations, whether driven by motors, engines, gas, or steam turbines, require but few high-caliber operating personnel and the maintenance required can be reduced to a low figure by proper engineering design. * * *

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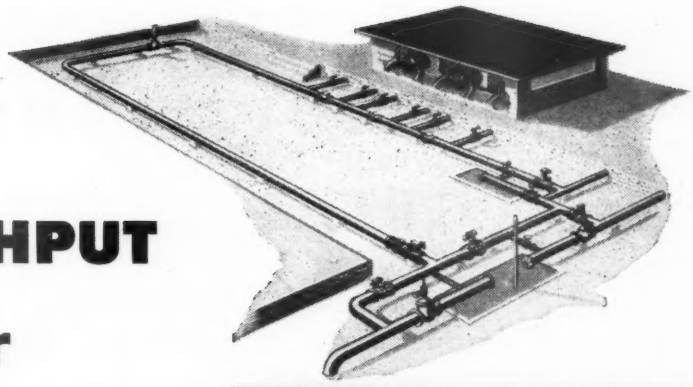

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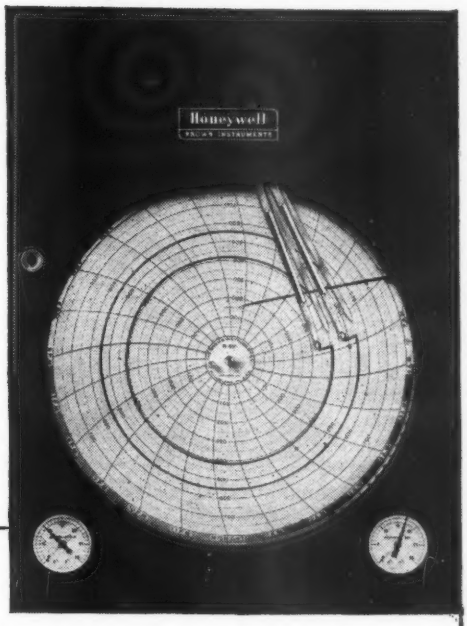

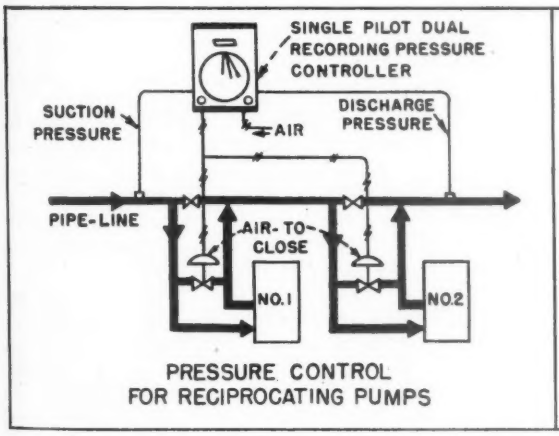

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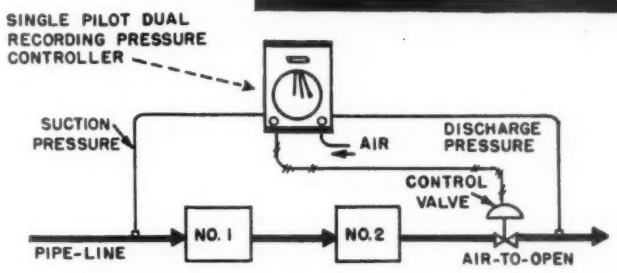

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INNOVATIONS HIGHLIGHT GREAT LAKES EXPANSION

Second postwar construction program, involving an expenditure of $55,000,000, gives system a 300 per cent increase in capacity

In 1945 immediately after the end of the war with Japan, Great Lakes Pipe Line Company began a construction program that increased capacity of its system by approximately 50 per cent, a capacity that based on forecasts of its shippers of their future demands would be adequate for many years to come.

Now six years later Great Lakes is in the final phase of its second postwar construction program and capacity of its system instead of being 50 per cent larger than it was in 1945 is 300 per cent greater.

Although each of these two expansion programs was entirely separate in planning and development, knowledge of the first and of events that followed are helpful in providing a background for the second. The later construction was planned so that increased capacity would be provided in progressive steps on various sections of the system, but had construction not been thus planned circumstances would have made such a procedure necessary.

Not only did the construction of 1945-47 increase capacity of the Great Lakes system, it expanded pipe line service for the carrier's Oklahoma and Kansas refiner-shippers. A new line was extended from Kansas City to the northwest to serve the existing terminal at Omaha, Nebraska, and new terminals were constructed on this line at approximately 100-mile intervals at Sioux City, Iowa, Watertown, and Sioux Falls, South Dakota, Alexandria, Minnesota, and Fargo and Grand Forks, North Dakota. On the older section of the system terminals were built at Mason City, Iowa, and Mankato, Minnesota, to provide delivery facilities at 100-mile spacing.

With terminals spaced at these intervals shippers can move their products long distances by pipe line and then make deliveries from terminals in relatively short hauls by motor transport or railroad tank car.

In 1945-47 construction included more than an expansion of the system, many of the existing facilities also were modernized. Pumping stations were modified to comply with designs used in the new stations, piping arrangements embodied knowledge gained from 15 years of operation of a products system with old type circuitous manifolds replaced by a design that permitted a direct flow of products, new terminals provided efficient facilities for handling and loading into transports and tank cars nine different grades of products.

In 1945 one of the secondary goals of the company was to obtain sufficient line capacity to permit discontinuance of the uneconomic secondary pumping stations on several sections of the system midway between the 50-mile spaced primary stations.

Before final construction cleanup had been completed in 1947, growing traffic demand had forced Great Lakes to operate all existing secondary pumping stations and to seek new ways to increase further the capacity of its expanded system.

What Great Lakes shippers and all others in the petroleum industry had not foreseen in 1945 was that instead of decreasing, the demand for gasoline and other refined petroleum products would increase at an unparalleled pace with the advent of peacetime economy.

Automobiles and trucks filled the nation's highways at an ever-growing rate. On farms in the midwest and northcentral states served by Great Lakes the remaining work horses were sold or turned out to pasture with a resulting increase in rural demands for gasoline and distillate. Farm petroleum requirements were further increased as additional thousands of families discovered the convenience of oil burning heaters.

Construction of more new lines was out of the question in 1947 as pipe delivery could not be promised in less than two years. Obtaining additional capacity by adding conventionally powered secondary stations also was impossible as normal sources of power either were unavailable or unfeasible.

The solution to this difficulty was supplied by the engineering department of Great Lakes, which devised pumping units powered by war surplus liquid cooled Allison aircraft engines, the first time this type of power had been used in the industry. Twelve of these units were placed on three sections of the system, south, north, and northwest of Kansas City, and Great Lakes instead of having eliminated secondary stations had a dozen more in operation. Constant improvements in design of the unit and in methods of operation made it a dependable source of power that enabled the carrier during the period the units were used to move several million barrels of products that it otherwise could not have transported.

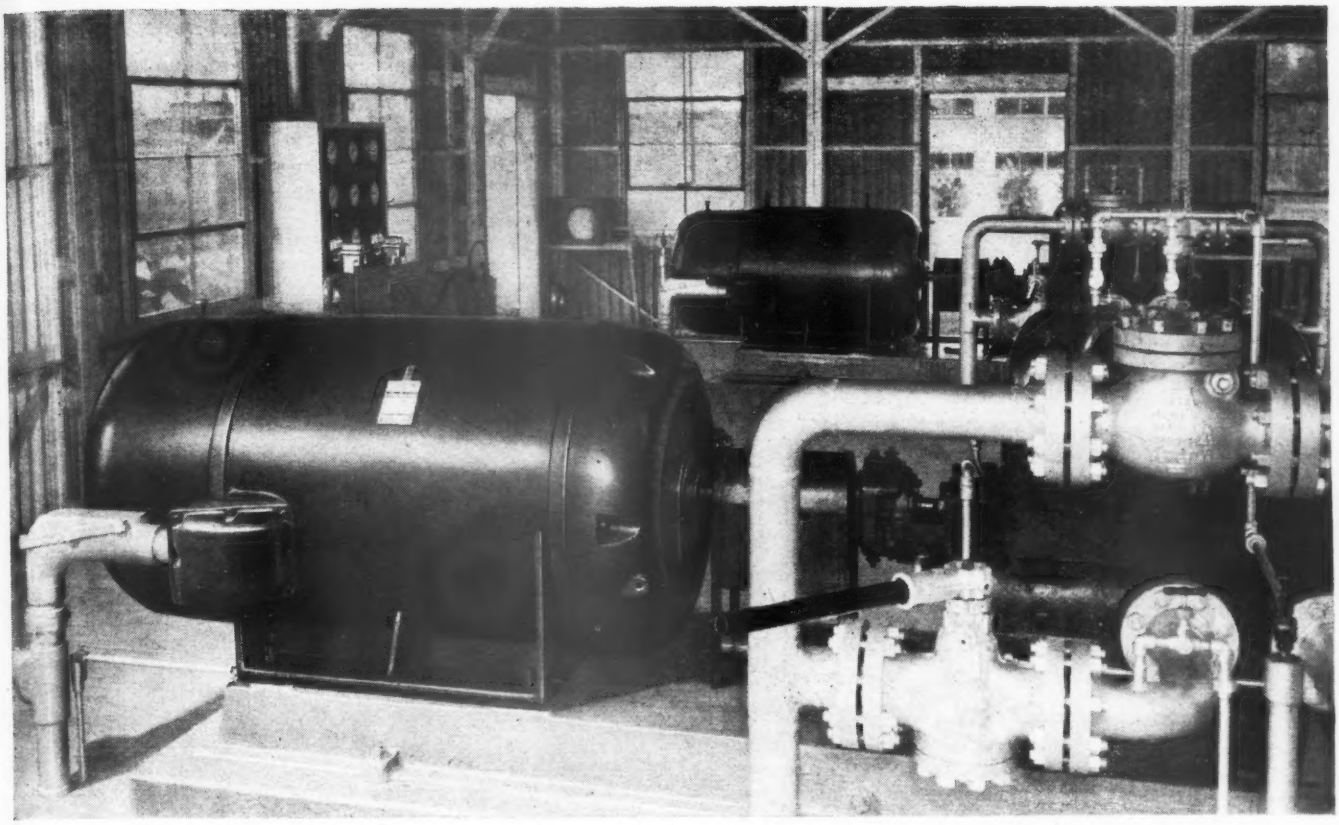
Inability to obtain firm delivery dates on pipe and equipment was the first deterrent to Great Lakes in beginning a second postwar expansion, and then another complicating factor arose. There were 18 companies that originated shipments from 17 locations to consignment to 14 company terminals in 7 states, in itself a complex factor in planning, and now various shipper companies began to expand capacities of their refineries and others announced similar plans to meet the growing demands for products. Until capacities of the various connected refineries were known, it was impossible for the carrier to determine accurately volumes that would be available for movement over its system.

This was the situation that prevailed through 1948 and the first half of 1949 as Great Lakes concentrated on transporting for shippers as much tonnage as possible with available facilities.

By late spring of 1949 deliveries of pipe and equipment were promised on definite schedules and refinery expansions were completed or plans were definite. Shippers were asked to supply the carrier with the volume of products then available for transportation to various sections of the Great Lakes system, and estimates of future volumes.

Based on these studies plans were made for expansion of Great Lakes facilities, with the primary objective to provide capacity sufficient to move by pipe line the entire volume of products manufactured by shippers for the area served by the pipe line company, and with a reserve capacity for future demand increases. As in the 1945-47 expansion, another goal was elimination of uneconomic secondary pumping stations.

Financing for the expansion was provided by sale of a $55,000,000 bond issue to private investors in July, 1949. This was $25,000,000 more than was ex-



Driving the main pumps in a Texas pipeline station, these two G-E explosion-proof induction motors—each rated 350 hp—are controlled either from master panel in control building outside or from the two G-E explosion-proof push-button starters at left.

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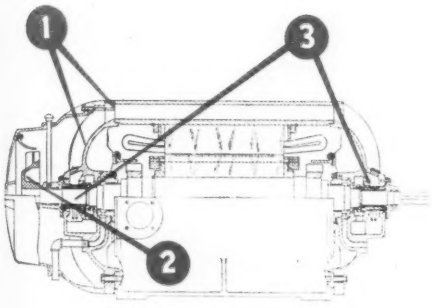

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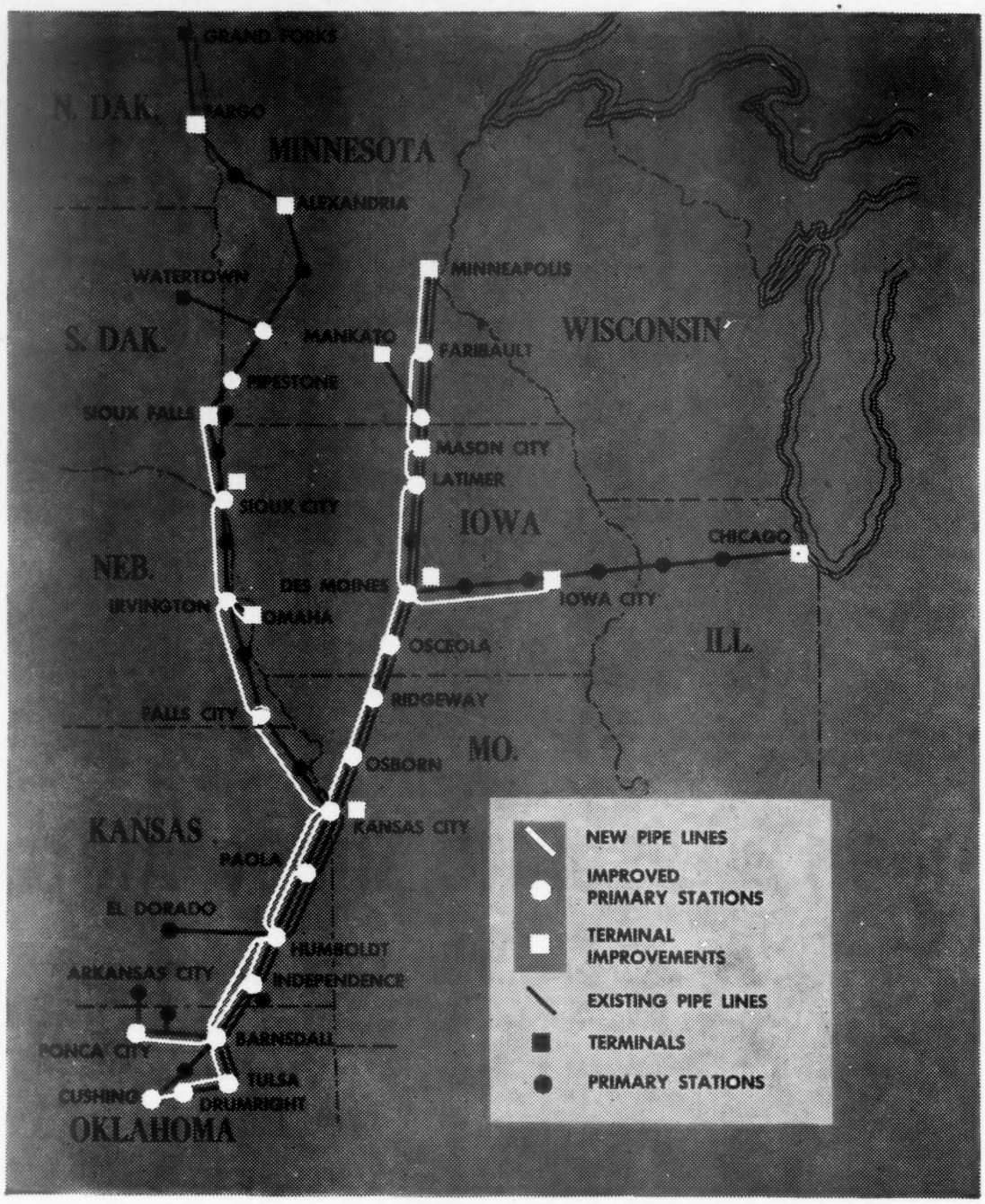

Map of Great Lake Pipe Line Company's system.

pended in the 1945-47 program. Initial construction was planned for sections of the system where need for increased capacity was greatest, followed by expansion of other sections based on continued studies of traffic demands.

Never before at the beginning of construction had Great Lakes had available and promised traffic so far in excess of its existing capacity. To meet this need principal line diameter was increased to 12 in., which, under similar operating conditions provides a capacity approximately equal to three 8-in. lines.

Construction Plans

First projects scheduled for construction were 930 miles of 12-in. line from Ponca City and Tulsa to Minneapolis through Kansas City, Des Moines, and Mason City; another 12-in. line from Kansas City northwest to Omaha, and a 45-mile 8-in. line from Cushing through Drumwright to Tulsa. Before the 12-in. line was completed to Omaha it became apparent that further capacity was required on the northwest leg of the system and the line was extended 165 miles to Sioux Falls.

Pumping equipment for the 12-in. lines was installed by enlarging alternate existing station buildings on the route of the parallel smaller lines. This provided station spacing of approximately 100 miles for the 12-in. lines.

In addition to expansion of existing pumping stations, a new station was erected at Pipestone, Minnesota, to provide further capacity of the 8-in. line beyond Sioux Falls. New buildings also were erected at Cushing and Drumright, and a total of 16 stations were enlarged to accommodate new equipment.

Additional transport loading facilities and tankage were provided at 9 of the 14 terminals: Des Moines, Mason City, Mankato, Minneapolis, Omaha, Sioux City, Sioux Falls, Alexandria, and Fargo. New tankage also was erected at the Kansas City terminal, and at the Tulsa pumping station, an accumulation point for products to be pumped through the system.

In all, 77 tanks with a gross capacity

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● If you keep moisture away from pipe-line surfaces with a protective coating, you prevent corrosion. But there's one point to bear in mind: *ordinary* protective coatings just can't keep out moisture, year after year.

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of 3,780,000 bbl were erected. The largest addition was made at the Minneapolis terminal with 13 tanks having a gross capacity of 1,040,000 bbl.

At Minneapolis, Des Moines, and Omaha, three of the original company terminals, new transport loading machines similar to those developed for the new terminals built in 1945-47 were constructed, a new service building was erected at each of these locations, and tank lines and manifolds were modernized at Minneapolis and completed at Des Moines. The Omaha lines had been revamped earlier.

Initially in 1949 emphasis was to be placed on completing the 12-in. line from Ponca City and Tulsa into Minneapolis as soon as possible so that increased capacity would be available for transporting additional fuel oil to northern terminals during the heating season. It was planned to have the 12-in. line from Kansas City to the northwest ready to move gasoline in heavier volume ahead of the spring farming season.

Contracts were let for the Minneapolis-Des Moines section, which was divided into six spreads. Work was to start at the north end of the section, but pipe shipments were allotted to all six jobs so they could proceed simultaneously.

Pipe and tank steel had begun to move from the mills when the first blow fell early in October. A strike closed all mills and halted steel shipments.

To meet this contingency a change was made in construction strategy. It was decided to move sufficient footage of the 12-in. pipe already available to permit construction of four major river crossings ahead of the period when the streams would be frozen over. The rivers were the Mississippi at St. Paul, the Des Moines at Des Moines, and the Missouri and Kaw at Kansas City. In addition to these projects there was sufficient pipe to allow construction to proceed southward from Minneapolis through the congested area of South St. Paul to the Mississippi River and several miles beyond.

Had the strike not occurred, or had its duration been for days instead of several weeks, the line from Kansas City to Minneapolis would have been completed ahead of the onset of cold weather as October, 1949, was ideal for pipe line construction, warm and dry.

When the strike was settled in November and pipe shipments were resumed at a reduced rate, it became apparent the Des Moines-Minneapolis section could not be finished before cold weather. A shift in plans was again made and pipe shipments were concentrated between Des Moines and Mason City in an effort to complete this 112-mile section so that Mason City could be supplied gasoline from Des Moines, leaving the two 6-in. lines free to pump products to Mankato and Minneapolis. This attempt did not succeed as below zero temperatures closed in before work was completed. In one segment of the section, ditching machines were halted by granite glacial boulders, which normally would have been but a minor problem, but frozen in an unmovable position they formed an impassable barrier.

Not only were pipe delivery schedules disrupted and slowed by the steel strike, but deliveries of tank steel, engines, pumps, speed increaser gears, and other equipment were delayed far beyond original estimates and promised delivery dates reverted to the familiar pattern of repeated deferments.

Line Completions

First additional system capacity supplied by new lines came on March 31, 1950, when gasoline was turned into the 12-in. line at Des Moines for pumping northward to Mason City. Completion of other line sections in 1950 followed in this order: Ponca City to Barnsdall, Tulsa to Kansas City, Kansas City to Des Moines, Mason City to Minneapolis, Kansas City to Omaha, Omaha to Sioux Falls, and the 8-in. line from Cushing through Drumright to Tulsa.

As soon as each line section was completed it was tested, filled, and placed in operation, first with temporary pumping facilities and then followed with additional power that stepped up capacity as primary pumping equipment was completed at various locations.

At terminals the procedure was the same, tanks, lines, and loading machines were placed in operation as they were completed to contribute to the working and loading capacity of the terminal.

As construction progressed on certain sections of the system, plans were made to increase capacities of other sections, based on needs shown by current studies of traffic demands.

In October, 1950, contracts were let for a second 12-in. line on the 204-mile Barnsdall to Kansas City section. This second line supplied matching capacity out of Barnsdall, where the two 12-in. lines from Tulsa and Ponca City converge, and an incoming capacity at Kansas City equal to that of the two outgoing 12-in. lines to the north and northwest.

By providing equal line capacities on these sections, Great Lakes was following its practice of matching line section capacities whenever traffic justified such action so as to move products in a direct manner from origination to consignment points without having to take material into intermediate tankage.

Other studies had shown likelihood of a constriction of capacity from Des Moines south, and a need for further capacity each of Des Moines to Iowa City and Chicago. To meet the first phase of this problem it was decided to place the 12-in. line between Ponca City and Tulsa to Des Moines on 50-mile station spacing. Equipment was ordered and contracts were let to expand the station at Ponca City and at four locations between Barnsdall and Des Moines. An additional pumping unit was ordered for Tulsa. An 8-in. line was approved for the Des Moines to Iowa City section, with expansion and modernization of the Iowa City terminal and additional tankage at Chicago. Modernization of the Kansas City terminal also was approved, but start of construction on these projects was delayed until material and equipment were either on hand or definite shipping schedules had been established.

While additional capacity had been supplied to north and south sections of the system in the manner described, further capacity had been added to the northwest line beyond Sioux Falls. This 8-in. line was placed on 50-mile pumping with the addition of the new station at Pipestone and by operation of existing stations at Hawarden, Iowa, Willmar, Minnesota, and Fargo.

Even with these stations pumping, seasonal demands for products in this territory were in excess of line capacity and again the former temporary expediency for gaining capacity was brought into action. Four temporary portable units, two diesel powered and two powered by converted Allison aircraft engines, were set at locations between Sioux Falls and Fargo to provide 25-mile pumping when required. As these units were already on hand and because of the type of fuel they use, their standby cost is relatively small.

Early in January, 1951, the entire 1300 miles of new 12-in. lines were in operation with permanent stations pumping at 100-mile spacing, and the 8-in. line from Cushing to Tulsa was operating with permanent pumping units.

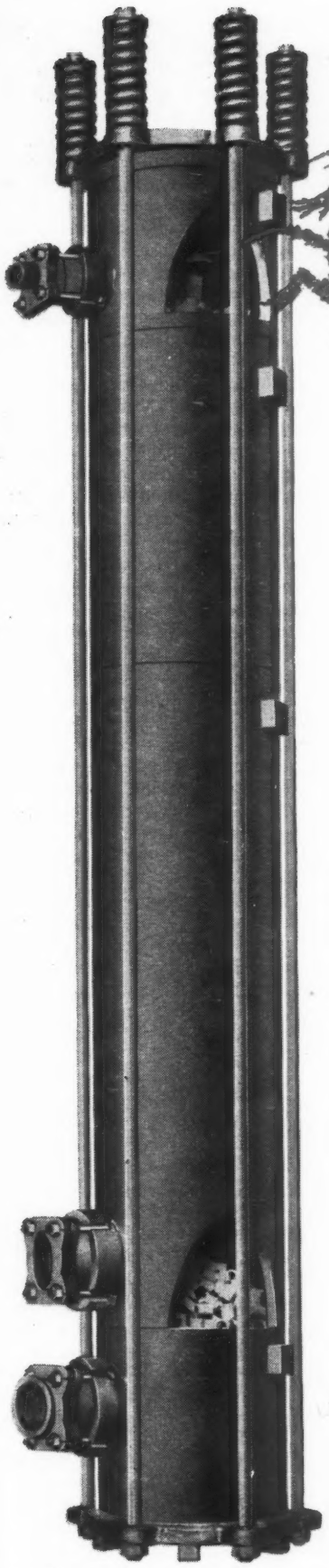
Thus was achieved one goal of the program, increased capacity over a long mileage of the system. When permanent pumping units went into operation on the new lines, secondary stations on parallel lines were closed down, attaining the second objective, elimination of most of the secondary stations on the system.

To solve the pipe supply problem for an 8-in. line between Des Moines and Iowa City, Great Lakes in the first half of 1951 made a figurative checker-board move by taking up an unneeded line from a section in Oklahoma and Kansas and moving it to Iowa to be reinstalled.

The unneeded line was between Barnsdall and Humboldt, Kansas, approximately 100 miles to the north. There were four 8-in. lines into Humboldt, three from the south and one from El Dorado, Kansas, to the west, and three outgoing 8-in. lines into Kansas City. After refineries at El Dorado had been expanded, traffic from there to Humboldt became so heavy that the line was in constant use, and consequently one of the lines from the south into Humboldt was idle.

The No. 1 8-in. line between Barnsdall and Humboldt, installed in 1930 as part of the original system, was taken up, cleaned, reconditioned, and shipped to the new location in Iowa. The mileage of pipe necessary to complete the line into Iowa City was purchased.

In July, 1951, the 8-in. line was placed



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in operation to give additional capacity into Iowa City from Des Moines. At about the same time the 12-in. line from Barnsdall went on 50-mile operation to provide additional capacity into Des Moines.

With the 8-in. line from Des Moines supplying Iowa City, full capacity of the 6-in. line is used to supply products for the Chicago terminal. This capacity was increased by reactivation of existing stations at Lee and Prophetstown, Illinois, east of Iowa City, which provide 50-mile pumping the entire length of the 6-in. line from Des Moines to Chicago.

A transfer also was made by Great Lakes to give the Chicago terminal additional tankage. This was done by cutting down four tanks at the Osceola, Iowa, station and reerecting them at Chicago. These tanks were built at Osceola when that station was a transfer point for products consigned to Omaha. From 1931 until 1945 products for Omaha were moved from the south to Osceola where they were taken into tankage and pumped westward to Omaha. The Osceola-Omaha line was sold in 1947 after the new line had been built from Kansas City to the northwest to serve Omaha and the other six terminals on this leg of the system.

Better utilization of its terminal tankage resulted from a change made in Great Lakes operating method when on May 1, 1951, a requirement became effective that gasoline be blended with tetraethyl lead before it is accepted at originating points. Previously unleaded gasoline had always been taken at originating points and blended at terminals of the carrier.

When gasoline was blended at terminals it was necessary to allocate an average minimum of three tanks to each grade, one tank for receiving, a second for blending, and a third to supply loading facilities.

With gasoline already blended, dye is added at the terminal as the material is being moved into the tank. Thus as soon as the designated volume of gasoline has been received, the tank can be used for withdrawals, making shipments more quickly available than formerly was possible, as well as eliminating the need for a third working tank.

With additional capacity available on nearly all sections of the system, and with smaller lines parallel to the 12-in., the larger lines have been used principally for transportation of gasoline while the largest volume of distillate has been moved through the smaller lines. This has made it possible to keep these two products separate by lines rather than by cutting one from another in a common line.

The expansion program is now in the final cleanup stage, with considerable tank and line painting remaining at several terminals. Work of modernizing the Kansas City terminal was halted by the July flood but will be resumed shortly. Equipment for modernizing the Iowa City terminal and additional tankage for this location are on order.

Since the beginning of the program in 1949 increased capacity has been supplied to 12 of the 14 company terminals, and additional capacity soon will be available to the remaining two that are served by lateral lines, Mankato and Watertown. This is being done by installation of another pumping unit at Albert Lea, Minnesota, the station that pumps to Mankato, and of a larger unit at Marshall, Minnesota, which pumps to Watertown.

To load the increased volumes that are being received terminal facilities have been expanded, and several of the locations have been modernized. Meanwhile Great Lakes is continuing its traffic studies to determine whether further growth is required to serve its shippers.

Line Construction

Pipe used in construction of the new Great Lakes Pipe Line Company lines conformed to specifications of the API 5XL requirement, which meant it had a yield strength of 42,000 psi as compared with a yield strength of 35,000 psi of pipe used in previous construction. This increase permitted use of lighter weight pipe at pressures considerably in excess of those considered safe by previous standards.

By employing a telescope method of construction, involving two weights of line pipe, a saving in steel tonnage also was effected. Pipe laid on the discharge side of pumping stations, and at locations where stations might later be added, had a weight of 41.5 lb per ft on the 12-in. Pipe of this weight was laid to line traverse points where studies showed lighter weight pipe could be installed to restrain safely the existing pressure. From this point to the suction side of the subsequent pumping station, 33.4-lb pipe was used. Utilizing the lighter weight pipe in this manner was possible without reducing the safety factor of the line.

Effectiveness of telescope construction is shown by a comparison on 1000 miles of 12-in. line. To construct the entire distance with pipe having a 41.5 lb per ft weight would require 110,000 tons of steel. Carefully planned telescoping, with 33.4-lb pipe combined with the 41.5 would result in a reduction of 11,000 tons of steel. With pipe cost arbitrarily established at $160 a ton for the comparison, the monetary saving would be $1,760,000.

Each joint of pipe received from the supplier with Van Dyke end caps attached. These caps were retained in place until immediately prior to welding. This practice, begun in earlier construction programs, prevents the accumulation of debris usually associated with new construction.

To get the same mechanical strength into weld metal as that contained in the pipe, 70-10 welding wire was used in the hot and cover passes of all welds. The stringer bead was 60-10 material.

After welding, the line was cleaned and coated under favorable conditions, which precluded presence of excessive moisture. Coating was coal tar with appropriate primer. The mastic was reinforced with 15 mil glass fiber wrap with an outside cover of asbestos felt in some instances and in others with an outer wrap of impregnated glass fiber.

The finished coating was tested with holiday detection equipment of standard design. To insure the line coating tested at least 1 meg ohm a square foot, an electric potential was impressed on it between insulated sections.

Occasionally those sections were considerably below standard and it was then necessary to run Pearson tests to find the specific damaged areas. After acceptance of the coated sections, appropriate cathodic protection was installed to arrest corrosion that might result from soil stress coating fractures. Usually the cathodic system consisted of a rectifier with ground bed. Where purchased electric power was unavailable magnesium anodes were used.

Insulating flanges were installed at 5-mile intervals in open country and at 1-mile intervals in congested areas, particularly in the vicinity of electrified railroads. When the locations of insulating flanges were adjacent to gate boxes it was customary to install them in the box.

Test leads were attached to the pipe by the cad weld process at each mile interval. These locations are used to check current travel along the line and also to determine pipe-to-soil potentials. These test leads are housed in conduit fittings at a fence line post.

In determining depth of line trenches, recognition was given to a farm cultivating practice known as deep plowing, which is used in certain areas. Lines were buried to a depth that would insure their not being damaged by a plow mold board or other cultivation implements.

Because of the efficiency with which present cathodic protection systems operate, the practice of overheading lines across streams has been largely discontinued. Areas where considerable rock damage in streams might normally occur is not excepted. In crossings constructed by Great Lakes an inexpensive mastic board was used to protect the line coating against abrasive damage.

In later phases of construction a new lowering-in device was used in lieu of the conventional belt sling so long accepted as standard. The new device carries the pipe load in a cradle where it is supported on pneumatic airplane type wheels. Rubber guide pulleys on the sides keep the line centered. The device has an advantage where direct cradling into the ditch is permitted in that it may be supported from a sideboom tractor that moves along at a rate commensurate with the construction speed. The cradle is hinged below the suspension point and may be opened for quick removal when necessary.

Except at river crossings it was standard practice to weld valves in the line. They were situated at points where fractures conceivably might result in sub-

stantial loss of product. It is Great Lakes' policy to place valves convenient to routes where easy access is obtainable in an emergency.

Pump Stations

Power units on the 12-in. lines at locations other than Kansas City and Des Moines consist of two diesel units with speed increaser gears driving 3-stage centrifugal pumps connected in series. Favorable power rates at Kansas City and Des Moines make electric units economically attractive at these points.

The turbocharged 8-cylinder prime movers on the 12-in. lines develop 1080 hp at 600 rpm and are similar in design to the 6-cylinder 810-hp engines installed on 8-in. lines in this program and in the 1945-47 construction.

In the speed increaser assembly, sleeve bearings are better adapted to support shaft loads than the roller type main bearings used in previous installations, in the opinion of Great Lakes engineers.

The gear increasers, couplings, and pumps were carefully analyzed for critical speeds and the final assembly is remarkably free of torsional vibration through the operating range.

The electric units at Kansas City and Des Moines are 900-hp induction motors directly connected to 3-stage centrifugal pumps. The piping assemblies that serve these units are constructed to permit relay operation of each station in series with others or they may be aligned to permit pumping out of storage. Under manual control at starting, the switch gear moves through a full sequential system that relieves the operator of any responsibility in bringing the units into line service.

A new feature at stations where there is tankage is the method of electronic control of all tank valves and pumps. By means of a coaxial cable tie it is possible to start or stop several tank pumps and their associated electric valves over a single wire. The operating frequency ranges between 10 and 22.4 kilocycles and the potential at which the control system functions does not exceed one-half volt. The control also includes a feature whereby a back signal is impressed on the coaxial cable when all functions have been fulfilled. This is to inform the operator that the tank is aligned for service. To accomplish the same functions with conventional line voltage control would require five wires to each tank and in addition it would be mandatory that they be carried in conduit to conform to code requirements. A further advantage is the ease with which the coaxial control may be extended to connect additional tank pump facilities if necessary.

A new type electric gauge is used rather extensively at product acceptance points. Although self-synchronous motors are a part of its design, considerable inventive skill is displayed in the manner in which a single motor is used to transmit a feet and inches reading to one receiving unit. In prior self-synchronous systems a pair of motors at the transmitting and receiving points were required to provide full gaging information.

In operation the assembly differs from other self-synchronous units in that the float does not continually turn the synchronous transmitter. A servo motor pulls the transmitter into gauging position through the medium of an oil clutch and tank measurement in feet and inches is readily obtainable by moving a double throw switch.

Any number of tanks may be connected to one receiver. The limitation on distance transmission is not burdensome if the circuit resistance does not exceed 25 ohms a wire. It is not uncommon to use these gages over a circuit of No. 12 wire for a distance up to three miles without resorting to amplification.

The new building at Pipestone and at station extensions conform to the Great Lakes standard design brick structure. An innovation was use of baked enamel steel paneling, acoustically treated, for wall facings combined with acoustic ceiling to suppress noise intensity. As many of these buildings are in areas where low winter temperatures are prevalent foam glass is used between the walls. To reduce work requirements and provide the ultimate in equipment consolidation, engine coolant circuit pipes are indoors and usually underground.

At the two originating stations where new buildings were erected, a type of wall section utilized in recent years for industrial building was employed in the structure. It has the advantage of being fabricated quickly of standard wall sections, and although the footing and foundations extend some distance above ground, the investment in this material is not substantial. The aluminum panels are attractively ribbed to eliminate the drab exterior usually associated with metal buildings. The structure has the further advantage of being readily expandable by addition of panel and wall sections should the need arise. Each panel carries its own insulating material. Great Lakes engineers believe that in the forseeable future buildings of this pattern may be used at locations that have extremely cold winters.

Terminals

Terminals of today are basically designated to provide adequate facilities for motor transport and railroad tank car loading. This is in contrast to the earlier purpose of Great Lakes terminals when their sole function was the loading of railroad tank cars.

To arrive at an accurate determination of the adequacy of loading facilities requires that full utilization be made of the experience garnered in areas where terminals are located. For example, one may conclude a terminal loads out a constant volume each day, yet during the peak periods the rate of delivery may be 75 per cent greater than the average for the day. Again there may be a further complexity in which a def-

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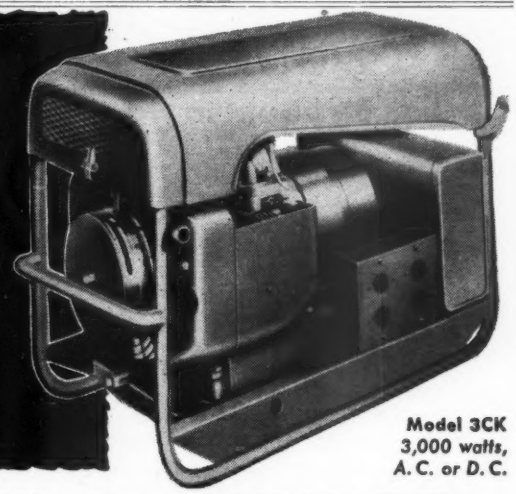

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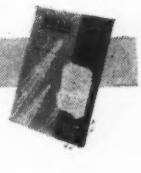

inite product may be in demand for a short period of the day and if loading facilities are not available excessive congestion results. It is therefore essential that consideration be given to all these features in order to provide and construct a balanced design and yet have its cost remain within definite economic limits.

All this finally resolves itself into sufficient tankage, large loading lines, enough pumping units at each tank to provide full volume for peak periods, adequate space for trucks during congested periods, a flexibility of design in the tankage system that allows any tank to be shifted from one product to another with full assurance that commingling or contamination will not occur. The loading machines and service building are considered the operating heart of the terminal system.

Loading machines are control connected to all tanks at each terminal and it is possible for a loader to start the loading pump at any tank for the delivery of any one of nine grades of products to each loading island. An innovation in volume control delivery is a flow apparatus that energizes additional tank pumps to maintain sufficient flow rate to the machine up to certain limits. It is not uncommon to find as many as three 30-hp loading pumps connected for parallel line delivery to loading facilities.

One pump is under control of the rack operator and the other two automatically start and stop to accommodate the loading rate condition. This function is initiated by an orifice differential, which in turn actuates a bellows micro switch to start the sequence for providing additional pumps.

As many of the terminals load tank cars and transports simultaneously and the locations of these two facilities are rather remote from each other, it is essential that the operator loading tank cars shall not shut down the unit that serves trucks if these loading facilities happen to be in dual service. An electric interlock in the electronic control system is provided in the circuit to overcome this problem. In addition, the feed line from each tank to the truck and tank car racks is common to both and because the pressure in tank car loading lines is much less than on truck lines, flow control mechanisms are installed to prevent the truck facilities from being starved during periods when tank cars are being loaded.

Other features are the addition of dye to the incoming stream through educators and their associated power pumps. Each loading tank is equipped with circulating spiders, electric gages, and electric powered incoming and loading valves.

Because of the size of new lines it was not possible to utilize the cartwheel arrangement for transferring streams that is used at terminals served by smaller lines. Although a fully automatic receiving system was designed for pneumatic operation, cost prevented its being acceptable.

The manifold finally adopted is designed so that products differing substantially in specifications are never received through a common facility.

For fire protection at loading racks a dry chemical has been provided with sufficient facilities to allow the operator to concentrate a large volume of chemical on any transport or line that might accidentally take fire.

As all new terminal buildings are in areas where extreme winter conditions prevail, the comfort of working personnel and the public was stressed in design of buildings. Walls are fully insulated against the most extreme cold. Aluminum windows with full storm protection were installed and all outside doors are protected by storm entrances so that heat loss can be maintained at a minimum. Hot water convectors are used for heating and these have the advantage of supplying considerably radiant energy. The entrance doors of heavy glass are aluminum trimmed and the inside walls are finished with baked enamel steel paneling. Where partitions are used a patented steel wall section is employed and it may be moved at will to accommodate floor plan rearrangements. The office floor is supported on tubular steel sections through which service power wires and telephone wires may be installed without having to resort to floor chasing, which unusually is unsightly. Buildings are well lighted, both artificially and from natural sources. The design is patterned to permit expansion without interfering with original structural sections. * * *

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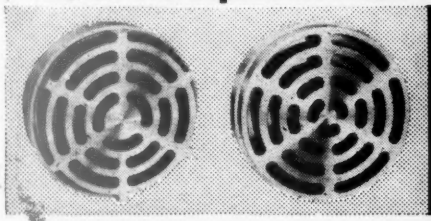

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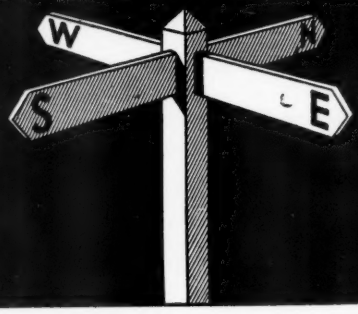

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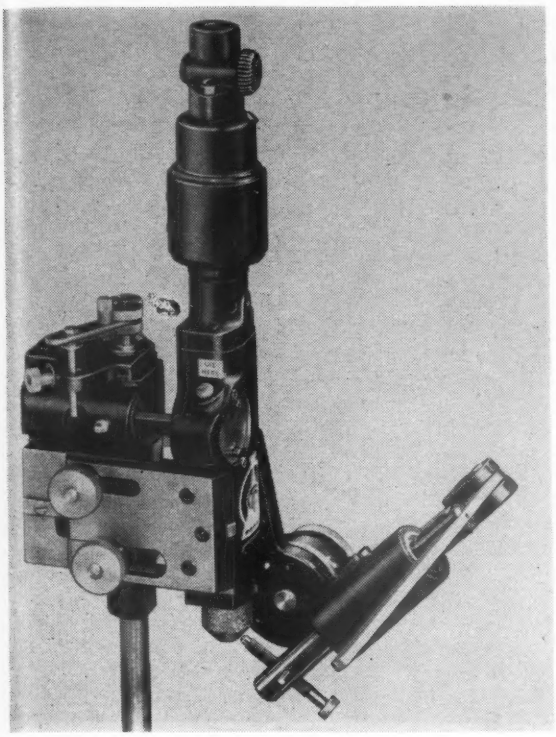


FIG. 1. Thompson portable valve seat grinder with wheel dressing unit attached. Any angle from 0 to 90 deg may be obtained for grinding seat faces and counterbores, left.

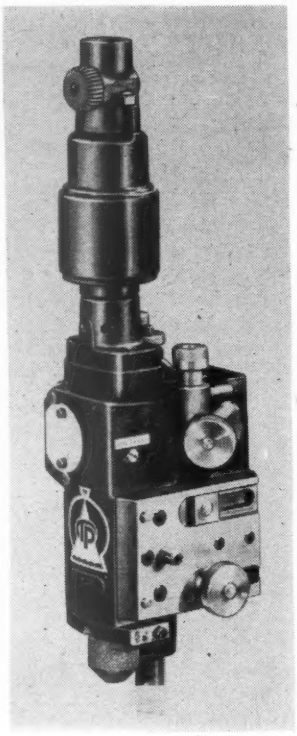


FIG. 2. All controls for the valve seat grinder are easily accessible to the operator. This view shows the unit as it is used in operation.

REGRINDING VALVE SEATS

Maintenance in the field contributes to efficiency of internal-combustion engines

J. D. CREEK*

CLOSE engineering cooperation, plus practical suggestions from the field, are important contributions in development of new and money-saving equipment. In fact, were it not for such cooperation between those who use the equipment and those who manufacture it, many modern-day advancements in equipment design and construction would never have been brought about.

For example, operators of large internal-combustion engines for years have faced the troublesome and costly problem of repairing and overhauling engines in the field. Re-grinding valve seats is an important maintenance operation. Most valve seat inserts used today are of special alloy steel, designed for high temperature service in large gas and diesel engines. Because of their hardness it has been difficult to overhaul them in the field. Thompson Products, Inc., West Coast plant, has developed the grinder described here for this purpose.

Although the basic problem of engine valve maintenance in the field had long been recognized. Thompson engineers gathered data and suggestions from the engine operators themselves. These were incorporated into the grinder's design, construction, and operation. Briefly, here are some of the basic requirements established from this survey. First, the grinder should be completely portable, as its operation would often be in the most remote areas, under a wide range of field operating conditions. It should be easy to operate, because the training and skill of factory mechanics would be unavailable in field maintenance work. The unit should be rugged, to withstand all sorts of field conditions. It should be readily adaptable to various engine sizes and makes so that a single grinder could be used on all, or mostly all, engines owned by the operator. Simple maintenance was another important "must" on the list of the operators.

Because of the extreme accuracy required in grinding valve seats and counter bores in large engines, the element of human error had to be kept at a minimum in the operation of the grinder. The unit here described, therefore, is of extremely simple design and any good mechanic can quickly learn to do a precision job in a matter of minutes. Using the correct grade of wheel, the unit will grind perfect seats in any material from hard-faced steels to cast-iron.

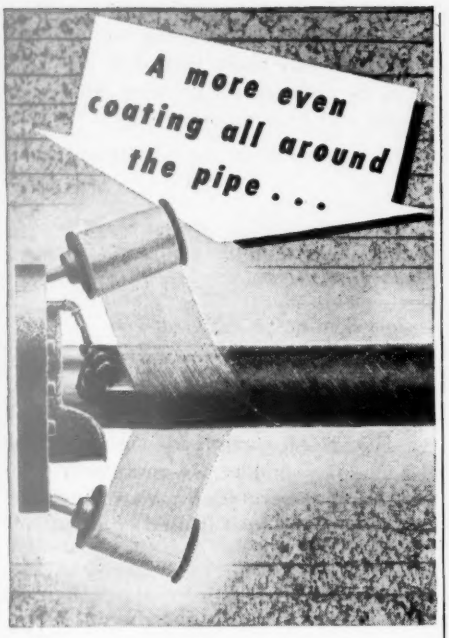
Fig. 1 shows the grinder complete with wheel dressing unit. Fig. 2 shows it with the dressing unit removed and ready for operation on the engine. The complete unit is easily portable, weighing but 22 lb, and may be used with equal ease either in the shop or directly on the engine, wherever air pressure is available. All working controls are readily accessable to the operator.

The compact and rugged design is shown in the construction of the pilot head and the grinding head. These are held rigidly in position by horizontal side plates with a tongue and groove design, permitting easy adjustment of the grinder head either outwardly or inwardly through the full grinding range. Quick adjustment is obtained by means of a gear and rack mechanism actuated by a knurled hand wheel atop the unit. The grinding head is locked in position by means of a hand wheel on each side of the unit.

The grinding unit alone is about the size of a cigar box, small enough to get down to work in almost all engines that have seats from 3¼ in. to 12 in. OD. The grinding unit is power driven at 10 rpm around a pilot centered in the valve guide. Only a small portion of the cutting surface of the grinding wheel itself engages the seat face, but the wheel rotates at approximately 12,000

*Manager, Industrial Products Division, Thompson Products, Inc., West Coast Plant, Bell, California.

EXCLUSIVE



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VITRON reinforcing means longer life for your pipe coating.

High reinforcing strength of VITRON Wrap resists damage from impact and soil stresses, and retards cold flow of coating.

VITRON Wrap is made of known composition glass of tested durability, unaffected by application temperatures.

VITRON Glass Fibers absorb no moisture; help maintain a high dielectric rating.

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FIG. 3. Grinding 4-13/16-in. seat face diameter.

rpm. This method of grinding—using only a relatively small portion of the wheel—prevents egg shaped seats, assures accuracy, rapid removal of stock without chatter, a minimum of downtime for wheel dressing, and a smooth, low micro-inch finish.

Vibration is the enemy of precision grinding operations, and Thompson engineers solved this problem by making the grinding unit housing and the wheel dressing unit of cast-iron to absorb vibration and avoid chatter. To simplify wheel dressing, the dresser is attached directly to the grinding unit, thus permitting the dressing of wheels without removing the grinder from the pilot. The actual wheel dressing operation is performed by a diamond tool in the end of the dresser shaft, and any angle from 0 deg to 90 deg may be obtained. The grinding wheel spindle is mounted on one double row, preloaded ball bearing, and one single row bearing.

In selecting the driving means for the valve seat grinder engineers faced a question of what type of power would be available in the field, as well as what type of power would be the most dependable and safe. The answer to these questions resulted in the selection of an air motor drive for the grinding unit. As the grinder would see service in gasoline plants and gas compressor stations, air operation would prove the safest, they decided. Moreover, the air motor provides the greatest horsepower per pound of weight—the motor weighs but 3½ lb and produces a high initial torque. The motor operates most satisfactorily at air pressures from 90 to 150 psi, from high volume tanks.

As the pilot around which the grinding head revolves is installed within the bore of the valve guide, perfect alignment between valve and seat is assured. A reversible ratchet feed is mounted on top of the grinder unit for feeding the unit into the work in 0.001 in. depths. By reversing the ratchet the unit is lifted from the seat after the grinding operation is completed. A highly accurate cut can be taken with this ratchet feed.

The rotary grinder can grind counter bores as well as seat face angles. A knurled hand wheel for rapid adjustment and a calibrated hand wheel for fine adjustments provide micrometer accuracy for feeding the grinder outward during the grinding of counter bores.

The unit regularly holds concentricity within 0.003 in. in grinding valve seats and is capable of grinding seats concentric to the guide bore within tolerances of 0.001 in.

Three models of the valve seat grinder cover the range of engine valve seats having inside diameters from 2 15/16 in. to 12 in. Thus, in a small portable unit of extreme operating accuracy, Thompson engineers and the engine operators themselves solved one of the most difficult problems of maintaining peak efficiency in large engines used throughout industry. * * *

☆ ☆ ☆

The Bonneville Power Administration was set up by an act approved August 20, 1937. In its first full year, 1939, $3,505,232 was spent. The estimated expenditures for 1952 are 15 times as great, or $53,200,000. That is $7 million more than the combined 1950 net income of Detroit Edison Company and Commonwealth Edison Company (Chicago area).

—*Tax Outlook.*

New officers and directors. Standing: T. A. Hester, R. H. Fulton, C. C. Bledsoe, Robert A. Conyes, A. L. Forbes, Jr., J. C. Britton, and Richard A. Gump. Seated: M. S. Williams, H. C. Price, Felix M. Johnson, R. D. Sheehan, and Ray L. Smith.

Pipe Line Contractors Hold Largest Convention

FRANK H. LOVE*

ALTHOUGH ending on a tragic note in the death of the newly elected president, A. L. Forbes, Jr., the Pipe Line Contractors Association held its most successful meeting to date at the Shamrock Hotel in Houston, Texas, January 8 and 9. Approximately 500 registered as compared with 400 a year ago. The scope of the meeting was enhanced this year by attendance of many contractor superintendents.

Forbes, concerning whom a more detailed story appears elsewhere in this issue, boarded a plane the morning following the close of the meeting and died of a heart attack while enroute to Bangor, Maine. By action of the board of directors Robert A. Conyes of the Conyes Construction Corporation, San Pablo, California, first vice president, was elevated to the position of president. Robert Thomas of Texas-Louisiana Contractors, Fort Worth, Texas, was named to occupy Forbes' seat on the board of directors.

Other new officers are M. S. Williams, Anderson Brothers Corporation, Houston, vice president, and C. C. Bledsoe, Midwestern Constructors, Inc., Tulsa, Oklahoma, treasurer.

Richard A. Gump continues as executive secretary.

New directors, in addition to Thomas, are Conyes; R. D. Sheehan, Sheehan Pipe Line Construction Company, Tulsa; Felix M. Johnson, Trojan Construction Company, Inc., Oklahoma City; J. C. Britton, Britton Contracting Company, Inc., Washington, Pennsylvania, and R. H. Fulton, R. H. Fulton and Company, Lubbock, Texas. These directors were elected for a term of two years.

Holdover directors, who have one more year to serve, are: T. A. Hester, Oklahoma Contracting Company, Dallas, Texas; Ray L. Smith, Ray L. Smith and Son, Inc., El Dorado, Kansas; M. S. Williams, Anderson Brothers Corporation, Houston; Clark C. Bledsoe, Midwestern Constructors, Inc., Tulsa, and H. C. Price, H. C. Price Company, Bartlesville, Oklahoma.

A new type of membership was created at this year's meeting. The group, for which a name has not yet been selected, will include sub-contractors engaged in specialty work such as stringing, coating, river, and road crossings, etc. The three types of members thus are: Active members, the new classification, and associate members. The latter consists of equipment manufacturers, dealers, and suppliers.

The board of directors elected four honorary members, all retired contractors. These are W. G. Hanrahan, Dallas; O. C. Whitaker, Fort Worth; Oscar Dempsey, Tulsa, and John C. Truman.

Another action by the association was the passing of resolutions on the deaths of T. R. Jones, first association president who died May 20, 1951, and Eugene Seth McCoy, superintendent for Anderson Brothers Corporation who died a few days prior to this year's convention.

The first speaker at the general meeting on the opening day of the convention was John W. Volpe of Volpe Construction Company, Malden, Massachusetts. His subject was "One Hundred Ways to Save a Buck," a talk on safety. The five points Volpe considers essential to an effective safety program are these: (1) Obtain and retain top management interest, (2) publicize the safety program, (3) develop a safety program for each job, (4) cooperation and contribution of the insurance carrier, and (5) install safety program on a competitive basis.

Following his talk Richard Gump, executive secretary, presented the association's "Safety Manual for Pipe Line Construction." This manual, copies of which were made available to those present, was prepared by a committee from the Pipe Line Contractors Association with the assistance of safety engineers from several insurance companies. Its purpose is to make available to the pipe line construction industry some practical suggestions and assistance in carrying out a safety program.

"Forethought and Taxes" was the subject of a talk by Iverson Walker, of Carrington, Gowan, Johnson, and Walker, tax specialists of Dallas. He suggested these basic methods for reducing taxes: (1) Taking capital gains instead of income, (2) spreading income, (3) deferring income, and (4) increasing deductions and credits.

The need for standardization of specifications was brought out by J. C. Stirling of the Service Pipe Line Company, Tulsa, in his talk "Pipe Line Construction Practices." Stirling also is chair-

*Editor, Oil and Gas Pipelining.

man of the API Sub-committee on Pipe Line Practices, which is now working along these lines. He made it clear, however, that the thoughts expressed in his address were his own and did not necessarily represent the views of the API or his company. In stressing the desirability for simplicity and conciseness in pipe line specifications he cited the fact, for example, that there are 71 different combinations of coating specifications, many of which overlap. The number could be reduced to not more than 12, he said.

Another example of the lack of uniformity in specifications is the wide difference of opinion among operating companies with regard to the depth at which a pipe line should be buried. Stirling pointed out that at a 3-ft depth there is only a 40 F temperature difference between high and low throughout the year. It would require a temperature range of 219 F to produce stresses in 40,000-psi yield strength pipe to equal its elastic limit, and 320 F to equal the ultimate strength of the pipe. These figures were cited to illustrate that sometimes depth requirements are entirely out of line with fundamental needs.

At the morning session on Tuesday, January 9, Karl L. Fetters, assistant to the vice president in charge of operations, Youngstown Sheet and Tube Company, Youngstown, Ohio, discussed "Line Pipe." He described the various methods of manufacturing large-diameter line pipe, discussed the properties of pipe, and told something of what is being learned about the stresses that prevail in pipe lines in service. On the matter of stresses his remarks concerned metal fatigue and the effects of soil stresses.

The morning meeting was concluded with a discussion of labor agreements.

At the afternoon session the discussion of labor agreements continued, followed by the conduct of general business, the report of the executive secretary, and the election of officers and directors.

The convention was concluded with the annual banquet in the evening. The speaker was Gardiner Symonds, president of Tennessee Gas Transmission Company, whose subject was "Future of Pipelining."

"One thing we know for certain about the future of oil and products lines—a considerable mileage of them is going to be built, and soon," Symonds stated. "There are many fields that either have no pipe lines or have inadequate pipe line capacity, some with flush new production," he pointed out. "Likewise, the demand for gasoline and various other petroleum products has grown in various areas to a volume that will justify the investment in products lines of large capacity. The defense agencies have set a policy of making steel available in 1952 to construct these needed oil and products lines, at the expense of proposed gas lines, if necessary."

Regarding natural gas pipe lines, he said that growth can be expected to be along the lines of development of market in depth rather than races for franchise territory, because all major areas of the country, except the Pacific Northwest, are now receiving natural gas service. The principal trunk line carriers will continue their growth by adding to capacity, which will be accomplished by construction of pipe lines parallel to their existing systems.

"All indications are now that there is a considerable unsatisfied demand for gas," Symonds asserted, and gave as his opinion that 1952 will be a substantial year of construction, although smaller than in 1951.

Monday's luncheon was sponsored by the International Harvester Company, Tuesday's luncheon by Caterpillar Tractor Company. At the latter, Harmon S. Eberhard, executive vice president, gave an address on "Outline for Construction Machinery."

Cocktail parties were sponsored by the Thew Shovel Company and Caterpillar Tractor Company.

For the first time entertainment was provided for wives of members. On Monday a reception was held and on Tuesday a luncheon. Both affairs were in the Western Room of the Cork Club.

In 1953 the convention will again be held at the Shamrock Hotel in Houston. January 19, 20, and 21. Beginning with next year, machinery and equipment will be exhibited every other year. ★ ★

THE PIG WITH THE POKE
CLEANS PIPE LINES
MORE BARRELS PER DOLLAR . . .
THROUGH OIL PIPE LINES
CLEANED BY WILLIAMSON PIGS
Type JR Pig 2" to 5" sizes. Economical and Rugged.
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Similar design for 10" to 14" sizes.
Brushes expanded by arched springs.
Brush and cup service life up to 1,000 miles.
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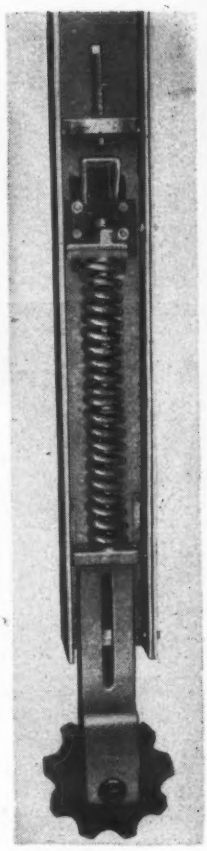
2 New Features Increase Output of Longhorn Ditcher

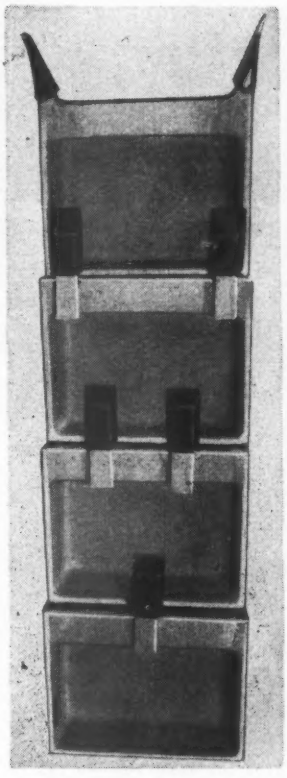
1. Spring loaded boom handles rock and stone--absorbs shock

By spring loading the boom of the Longhorn Mobile Ditcher it is now possible to dig much harder material at a faster rate and at the same time minimize the hazard of hidden obstacles. This new boom absorbs practically all of the shock load and enables the Longhorn to handle rock and stone up to 5 inches in diameter.



2. H & L Teeth stay sharp--are quickly renewed

With the bucket line equipped with H & L Removable and Replaceable Teeth the production output of the Longhorn is greatly increased. These tough alloy steel teeth, which are so widely used in dirt moving equipment, remain sharp at all times. Replacement time is reduced to 20% of the previous time for renewing cutting edges and replacement costs are reduced by 50%.



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Henderson, Texas

These new improvements are two more reasons we say, "When you invest in a Longhorn, you buy lower ditching costs." If you require small ditching equipment, it will pay you to look at a Longhorn Mobile Ditcher with its many exclusive features. We will be glad to arrange an actual demonstration. Just write, wire, or phone.

PICTORIAL

Informal shots taken at Pipe Line Contractors Association Convention in Houston

1. H. S. Shanks, H. S. Shanks and Son; H. K. Hynes, Thomas F. P. Kelly, and Warren E. McKenney, all of James E. Mavor Company, and M. E. Belsen of The D. E. Stearns Company.

2. O. C. Whitaker of Fort Worth, one of the old-time pipeliners now retired.

3. Sam Webster, Koehring Company, and H. J. Holdsworth, Parsons Company.

4. Richard A. Gump, executive secretary of association.

5. C. E. Hatcher, Crutcher-Rolfs-Cummings, Inc., and H. F. Finnerty of Mahoney Contracting Company.

6. George McComb, Standard Pipeprotection, Inc.; and R. V. Wilson, Engineers Limited Pipeline Company.

7. G. A. Armour and Hugh Baird of Standard Pipeprotection, Inc., and J. B. Harshman of H. C. Price Company.

8. Whitey Crose, M. J. Crose Manufacturing Company; John G. Tarpley, independent; Thomas Winkler, Stone and Webster.

9. Ainslie Perrault of Perrault Brothers and R. H. Fulton of R. H. Fulton and Company.

10. C. K. Rickel, Big Three Welding Equipment Company, and O. R. Smith, specialist in pipe line welding.

11. M. L. Stalls, E. R. Rathjen, and Ellis Dunn of Dunn Brothers, and Ted Schwantes of Northwest Engineering Company.

12. Lloyd Lippincott and Mary C. Harter, H & M Pipe Beveling Machine Company; C. K. Rickel, Big Three Welding Equipment Company; Felix Johnson, Trojan Construction Company; Mrs. Felix Johnson; Harry Smith, Big Three Welding; R. V. Wilson, Engineers Limited Pipeline Company; Floyd Berry, Big Three Welding.

13. One of the tables at the annual banquet.

14. Steve Day, S. D. Day Company; H. D. Carmouche, Houston Pipe Line Company; L. H. Wheeler, Houston Equipment Company; D. W. Peake, Standard Pipeprotection, Inc.; Bennie Means, Pittsburgh Coke and Chemical Company; G. A. Armour, Standard Pipeprotection; M. T. Duddleston, Fish Engineering Corporation; O. E. McCullough, Jr., Pittsburgh Coke and Chemical.

15. J. T. Brodie, Brodie Construction Company; Louis H. Byers, R. H. Fulton and Company; Bob Sheehan, Sheehan Pipe Line Construction Company

16. L. H. Favrot, president, opens meeting.

17. H. J. Masuhr, Jr., Allis-Chalmers, and E. L. Joe Morgan, Shaw Equipment Company.

18. Mike Curran of M. J. Crose Mfg. Co., and M. E. "Panama" Shiflett of Oklahoma Contracting.

NEWS

API Products Conference, Safety Committee to Meet

The third annual Products Pipe Line Conference, and the fifth mid-year meeting of the Safety and Fire Protection Committees of the American Petroleum Institute will be held concurrently in Fort Worth, Texas, during the week beginning April 20.

The Pipe Line Conference will be held in the Blackstone Hotel, beginning Sunday, April 20, and concluding Wednesday, April 24. The safety sessions will be held in Hotel Texas, opening Monday, April 21, and closing Friday, April 25.

As in past years, prepared papers, panel discussions, and field trips will feature the pipe line meetings. The program committee, under the chairmanship of G. F. Brigance, of Socony-Vacuum Oil Company, has arranged for seven papers to be presented at an all-day symposium on the second day of the conference (Monday, April 21). Titles of the papers and names of the authors will be announced later.

On the following day, an all-day field trip has been arranged. Pump stations of Humble Pipe Line Company, and The Texas Pipe Line Company, will be visited and a barbecue dinner sponsored by Humble, Texas, and Sinclair Pipe Line Company, will be served en route.

For Wednesday morning, a panel session is scheduled with eight specialists on hand to answer questions submitted by those present. In the afternoon, there will be a field trip to Sinclair's Fort Worth products terminal and Humble's terminal at Dallas, stopping en route at Sinclair's Arlington pump station and terminal, where a barbecue dinner will be served following a plant inspection tour.

The conferences are sponsored by the Subcommittee on Products Pipe Line Technology of the API's Division of Transportation, of which J. W. deGroot, of Tuscarora Oil Company, is chairman. W. H. Morris, of Sinclair, is serving as chairman of the committee on arrangements for the meeting.

A group session, which is expected to attract a large audience of both pipe line and safety men, is scheduled for Monday evening, April 21, by the safety committees. This session will feature addresses by H. H. Anderson, vice president of Shell Pipe Line Corporation, and James E. Moss, director of the API Division of Transportation. Anderson will discuss safety in pipe line operations and Moss will speak about safety in its general relation to transportation.

Another highlight of the safety sessions will be an all-day meeting of the Committee on Fire Protection Engineering.

Both pipeliners and safety men are urged by the chairmen of their respective committees to make their hotel reservations early, to assure themselves of adequate facilities for their Fort Worth visit.

R. H. Hargrove Reports on Texas Eastern's Activities

R. H. Hargrove, president of Texas Eastern Transmission Corporation, Shreveport, Louisiana, has released the following statement concerning his company's activities during the last year and what is planned for 1952:

"For all employees of Texas Eastern Transmission Corporation 1951 was a busy year. It is apparent that during the past year the company broke all previous records by about 15 per cent for volume of natural gas delivered through operating lines, although detailed and audited operating statistics and financial data will not be available for some time. At the same time the company and the contractors working on jobs for it made strenuous efforts to bring to early completion a $114,000,000 expansion project for which FPC approval was received on February 27, 1951.

"Right now it appears that the construction of a new 30-in. diam pipe line will be completed and ready for operation as far north as the first crossing of the Ohio River by early February. This will permit deliveries of additional needed natural gas to the Appalachian area during the current heavy consuming season.

"Completion of construction of Texas Eastern's new 30-in. line from the Ohio River to Uniontown, Pennsylvania, and construction of additional compressor station facilities east of Uniontown is expected by mid-1952. All river crossing and compressor station construction is currently underway and will be completed early in 1952. Pipe line and other construction of the Oakford storage project has already been completed. Oakford Storage is a giant natural gas underground storage project undertaken on an equal ownership basis by New York State Natural Gas Corporation and by Texas Eastern Transmission Corporation.

"Completion of this entire expansion program by summer of 1952 will assure Texas Eastern's being in a position to initiate deliveries to its affiliate, Algonquin Gas Transmission Company, in ample time for the period of heavy natural gas demand next winter.

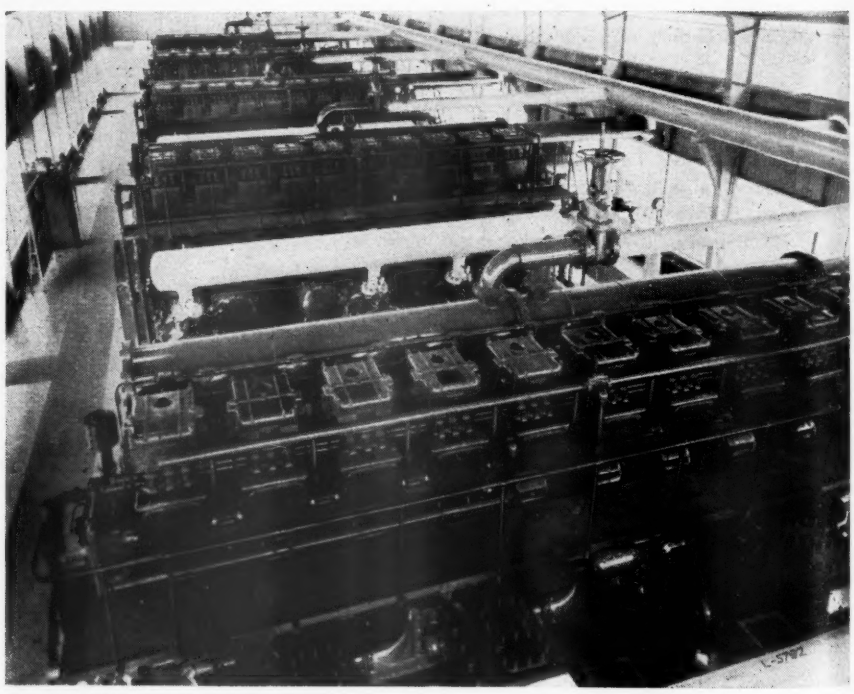
"In 1951 the organization of Texas Eastern Production Corporation was expanded and the groundwork laid for increased activity in the search for gas and oil in 1952."

Construction Begins on Sinclair's New Line

R. J. Tibbets, president of Sinclair Pipe Line Company, announces that construction on Sinclair's 24-in. pipe line between Cushing, Oklahoma, and East Chicago, Indiana, was begun December 29, 1951.

The new Sinclair Line will be 675 miles long and will form a part of one of the longest crude oil pipe line systems in the world. It will be equipped with seven electrically-operated pumping stations and will have a line capacity upon completion of 300,000 barrels daily at East Chicago. The project will cost upwards of $53,000,000 and will be one of the main arteries of crude transportation from the producing areas to the refining areas of St. Louis and Chicago.

The construction of the new line has received favorable action by the Petroleum Administration for Defense.



The Texas Illinois Natural Gas Pipeline Company system began operating recently with five stations. In each are five 2000-hp Worthington angle gas compressors. The interior of the station shown here is at New Caney, Texas.

An Executive Safety Committee for AGA

An Executive Safety Committee has been appointed by the American Gas Association to advise the gas industry on national accident prevention policies and to stimulate top management attention to the safety performance of gas industry employees. The new committee recently conducted a joint meeting with the AGA Accident Prevention Committee in New York at which time the industry safety problems were explored. A second meeting is listed in the near future at which some definitive action may be taken regarding safety policies for the gas industry.

Charles E. Bennett, president, The Manufacturers Light and Heat Company, Pittsburgh, and first vice president, AGA, is chairman of the new committee. Members of the committee are: Benjamin C. Adams, president, The Gas Service Company, Kansas City; H. Bruce Andersen, vice president, The Philadelphia Gas Works Company; M. A. Abernathy, vice president, United Gas Pipe Line Company, Shreveport; Henry Fink, president, Michigan Consolidated Gas Company, Detroit; John L. Haley, vice-president, Niagara Mohawk Power Corporation, Syracuse; J. F. Merriam, president, Northern Natural Gas Company, Omaha, and Charles G. Young, vice president, Springfield Gas Light Company, Springfield, Massachusetts.

Clearing Pipe Line Right-of-way. This Allis-Chalmers HD-20 crawler tractor equipped with Gar Wood cable dozer clears a right-of-way for a new pipe line near Lufkin, Texas. Freeing stumps from 4 in. to 4 ft in diam, mostly slash pine, is one of the many efficient tasks performed by this unit.

AGA 1953 Convention to Be Held in St. Louis

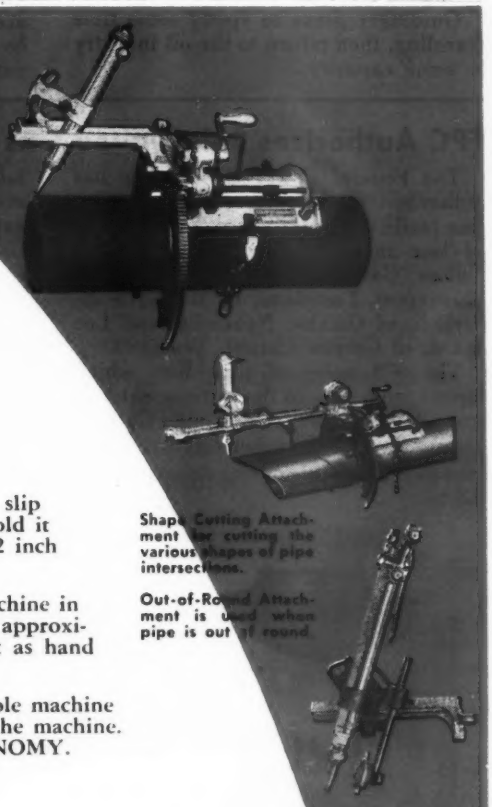
The 35th annual convention of the American Gas Association, which is expected to attract 5000 delegates, will be held at St. Louis, Missouri, the week of October 26, 1953. Site of the convention was recommended by the time and place committee under the chairmanship of Oliver S. Hagerman, chairman of the board, United Fuel Gas Company, Charleston, West Virginia. The report was approved by AGA executive board.

As previously announced, the 1952 convention will take place the week of October 27 in Atlantic City, New Jersey.

H&M

PIPE CUTTING AND BEVELING MACHINE

Cuts and Bevels Pipe FASTER, MORE ECONOMICALLY



Split horseshoe shaped gear permits machine to slip quickly over pipe. Fast operating snap chain fasteners hold it in place. A complete cut and bevel can be made in a 12 inch pipe in about two minutes.

You'll soon save several times the cost of the machine in labor, gas and transportation charges. H&M takes approximately one-half the labor and gas to make the cut as hand cutting and the work is all done in the field.

Bring this light (24 to 155 pounds) but durable machine to the pipe instead of moving the heavy pipe to the machine. Remember, H&M designs for SPEED and ECONOMY.

Shape Cutting Attachment for cutting the various shapes of pipe intersections.

Out-of-Round Attachment is used when pipe is out of round.

See for yourself. Let us arrange a demonstration.

H&M PIPE BEVELING MACHINE COMPANY

311 E. 3rd St. Tulsa, Okla.

Phone 3-0241

E. F. Guidinger of Phillips Honored Upon Retirement

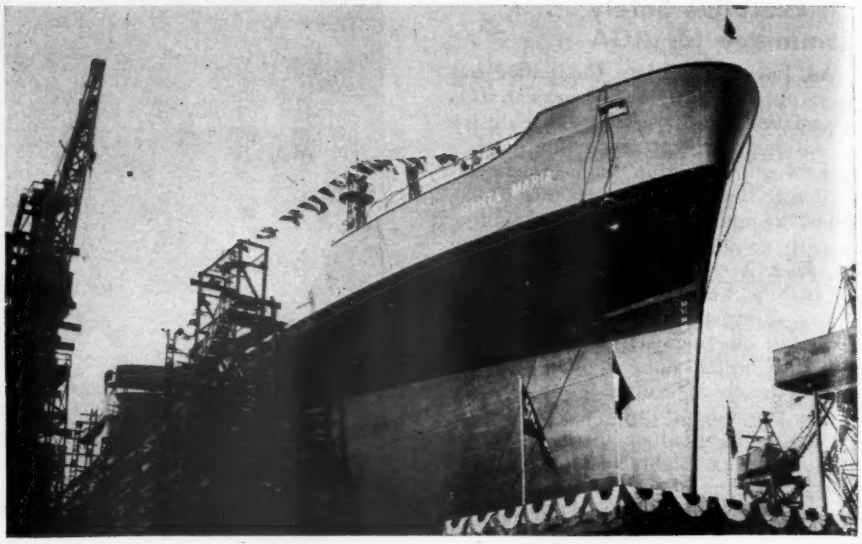
More than 200 members of the oil industry gathered in Bartlesville, Oklahoma, to pay their respects to Edward F. Guidinger, consultant to C. R. Musgrave, vice president supply and transportation, Phillips Petroleum Company, who is retiring after more than 26 years' service with Phillips.

Guidinger was honor guest at a dinner at the Adams building auditorium, at which Musgrave presided. The guest list included prominent oil men and newspaper men from all parts of the nation. The Bartlesville airport was crowded with private and company planes, and other guests arrived by train and automobile. The Phillips apartment hotel was filled with out-of-town guests here for the occasion. The visitors were taken on a tour of the Adams building, during the afternoon.

Guidinger, whose home is in Bartlesville, is a native of Schuyler, Nebraska. He received his bachelor of science degree from the University of Nebraska in 1908 and spent several years in the east. He came to Bartlesville in 1912 and worked for various oil companies until 1919 when he went into business for himself.

In 1925 Guidinger joined Phillips as petroleum engineer. In March, 1932, he took charge of crude oil sales and pipe lines. Later he became executive manager of crude oil pipe lines, and consultant to Musgrave.

Guidinger plans to spend some time traveling, then return to the oil industry in some capacity.



S.S. Santa Maria before launching at Sparrows Point, Maryland.

Union Oil Company Launches New Tanker

The most recent addition to Union Oil Company's tanker fleet, the *S. S. Santa Maria,* built by the shipbuilding division of Bethlehem Steel Company at Sparrows Point, Maryland, was formally launched on December 7, with appropriate ceremonies and some interesting sidelights.

The sponsor, Mrs. R. D. Gibbs, wife of R. D. "Frick" Gibbs, vice president of Union Oil Company in charge of transportation, christened the ship in the traditional manner and among others was accompanied on the ceremonial platform by F. A. Hodge, manager of the shipyard, and young Charles Leland Stafford, Jr., of Santa Maria, California. The latter was the winner of a recent essay contest instigated by Union Oil Company and carried on through the *Santa Maria Times.* Part of his reward for this achievement was a trip with his parents to the launching and another part was the award of a four-year scholarship to any college of his choosing.

Also present to represent Bethlehem at the launching was J. M. Willis, general manager of shipbuilding division.

The new ship is an 18,000-ton tanker of thoroughly modern design and will constitute a valuable addition to the substantial Union Oil Company fleet.

FPC Authorizes Sale United Gas Facilities

The Federal Power Commission has authorized the sale of natural gas pipe line facilities, including about 678 miles of line in Texas and Oklahoma, by United Gas Pipe Line Company, of Shreveport, Louisiana, to Martin Wunderlich, of Omaha, Nebraska, and Lee Aikin, of Corpus Christi, Texas.

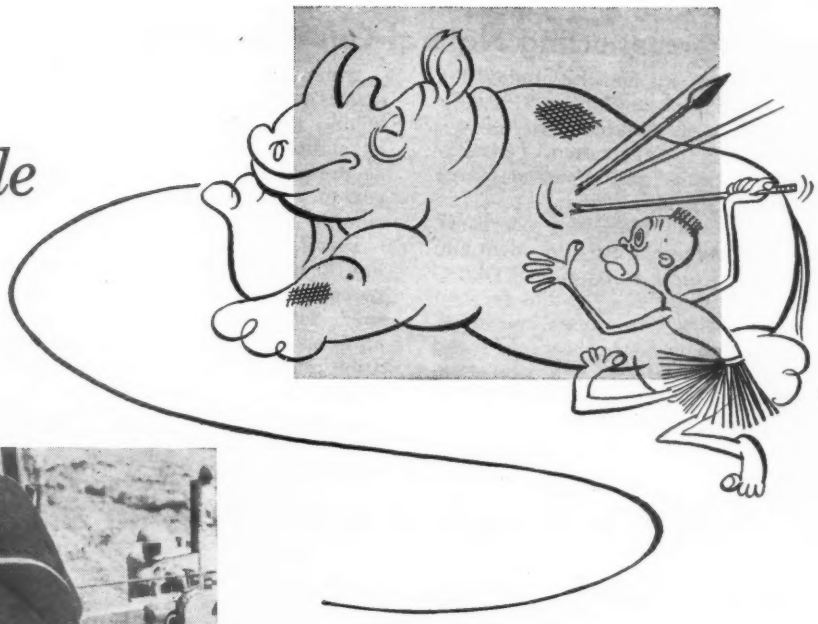
The 678 miles of pipe line, which ranges from 1 to 16 in. in diam. extends from Wheeler County to Young County, Texas, through Harmon County, Oklahoma. The two purchasers plan to pay about $5,000,000 for these facilities together with certain properties of United Gas Corporation and Union Producing Company, both affiliates of United, located in and around the Wichita Falls district. These properties comprise all facilities in United Gas Corporation's North Texas division and United Gas Pipe Line Company's and Union Producing's Wichita Falls district.

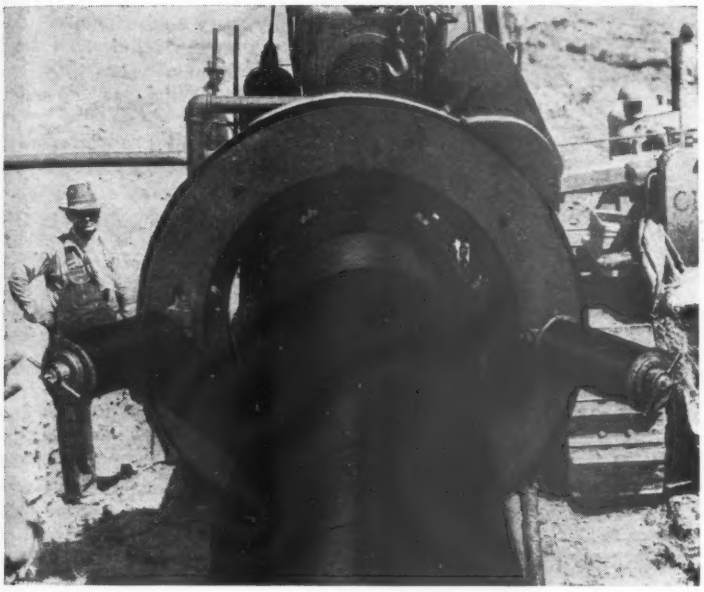
Wunderlich and Aikin have entered into a series of contracts with Lone Star Gas Company, of Dallas, Texas, under which that company will supply them with gas during 1952. In return, Wunderlich and Aikin will, by December 1, 1952, sell to Lone Star, for $5,752,339, all properties that they will acquire from United and its two affiliates.

The Commission placed two conditions on the authorization for the sale. The approval will not become effective unless (1) Wunderlich and Aikin file within 30 days an application for FPC approval of the transfer of the facilities to Lone Star; and (2) Lone Star files within 90 days an application for FPC authority to acquire and operate the facilities.

In authorizing the sale and acquisition, the commission pointed out that United's Wichita Falls District, which is not connected to the rest of its system, faces a critical shortage of gas, with only about 41,000,000 cu ft of gas a day available to meet estimated peak day requirements of 63,585,000 cu ft during the current winter. The commission further noted that the record shows that during 1952 Lone Star will be able to supply Wunderlich and Aikin with quantities of gas sufficient to operate on most days. Wunderlich and Aikin formed a partnership to operate the Wichita Falls district.

Like the Rhino's tough hide that protects what's inside...





Johns-Manville Asbestos Felt protects oil and gas pipe lines

MORE than 100,000 miles of oil and gas pipe lines are now protected by Johns-Manville Asbestos Pipeline Felt—*the only type of wrapper that has survived over 50 years of service in all types of soils.*

Johns-Manville Asbestos Felt is a sturdy, inorganic product. It has the thickness and toughness necessary for shielding pipeline enamels from earth load and soil stresses. It is resistant to rot and decay, and to acid and alkali soils. It permits the protective enamel coating to properly function against corrosion.

Johns-Manville Asbestos Felt is flexible. It wraps easily without cracking. It guards enamel from impact during installation of field-wrapped pipe, or during transportation and installation of mill-wrapped pipe.

There are economic advantages, too. In addition to reducing maintenance expense, Johns-Manville Asbestos Felt adds many years of life to the pipeline. For further information and a sample of Johns-Manville Asbestos Pipeline Felt, mail the coupon below.

JM PRODUCT

Johns-Manville
Asbestos
PIPELINE FELT

Johns-Manville
Box 290, New York 16, N. Y.
Please send me a copy of the sample folder on Johns-Manville Asbestos Pipeline Felt, PP-22A.

Name_____

Address_____

City_____ Zone____ State_____

Urges Interconnecting Natural Gas Pipe Lines

The nation's gas industry today had before it a plan to institute a $100,000,000 program of research and development looking to integration of its distribution facilities and expansion of its service to the public.

Author of the plan is Frederic O. Hess of Philadelphia, past president and a director of the Gas Appliance Manufacturers Association. "As the greatest fuel distribution system ever conceived, gas now influences the home life and comfort of 28,000,000 American families and motivates more than 25,000 different industrial processes," Hess told an executive session of the group.

"Such responsibilities," he said, "demand that the gas industry shall not fall behind the national average industrial expenditure for research, which appears at present to be approximately 3 per cent of all U. S. industry's total business volume."

Placing the gas industry's annual volume at over 3 billion dollars—including revenue from fuel, domestic and commercial appliances, and industrial equipment—Hess declared its appropriation for development each year should amount to 100 million dollars. The industry, he said, has consistently fallen far short of this goal.

"Our best thinking should be devoted to a study of ways to integrate the gas-supply system and correct some of its growing pains," Hess pointed out.

For example, the various natural gas pipe lines, now comprising a network of 260,000 miles, he said, might be extensively interconnected to provide greater flexibility, particularly when seasonal or other emergency conditions place extra stress on the system. Such interconnection from Kansas City eastward to New England and south to Tennessee, he stated, would benefit the public, the national welfare, and industry in general.

"We know how effectively such interconnecting and looping systems protect the electric industry against power failures, peak demands, unbalanced load factors, and excessive distribution costs," Hess said. "Why not the same system for gas?

"We have the initial advantage of dealing with a low-cost fuel and the additional advantage of being able to store it—something the electric industry has not been able to do with electric current."

Although gas is accepted as the "workhorse" fuel of millions of homes and industries, Hess said, no industry can disregard the need for constant development.

As a research goal, Hess further suggested a search for auxiliary gas supplies in the eastern half of the United States "to help solve our regional winter-load problems without piping natural gas over such great distances" as from the southwest.

The natural fuel, he pointed out, actually was first discovered in the east, and might well be produced there again in quantities sufficient to augment total national supply and bring about geographically balanced distribution.

Hess said a full-scale program of research and development for the gas industry is further justified by the fact that "our progress to this point has been due entirely to our own energy and enterprise, and we must make every effort to retain our independence and avoid subsidies and artificial supports of the type so readily accepted by other industries."

ROSKOTE cold-applied anti-corrosion mastic saves time...saves money...SAVES PIPE!

Roskote's drying speed, its handling ease and its high electrical resistivity makes it the ideal mastic for pipeline protection, winter or summer. Whether you are protecting distribution and service lines, or large transmission lines in yard or field, it will pay you to investigate . . .

cuts field costs because it is applied COLD — either brush, spray or special line-traveling machine — without primer or field mixing. It eliminates labor, equipment and hazards of hot-applied materials. It is fast-setting to a tough, flexible film of high electrical resistivity (20 megohms per sq. ft.) without brittleness or sag through a temperature range of −40° to 375°F. It dries to the touch in 20 minutes and is ready for backfill in an hour.

Roskote's resin base resists acids, alkalies, salts and moisture. It bonds readily to previous coatings of coal tar or asphalt. Wire brushing is the only preparation needed for old pipe.

Roskote's drying speed and handling ease cuts man-hours from work schedules and speeds pipe-line progress. That saves real money! Yet Roskote costs only 3¢ per square foot of coverage.

Used by over 70 utilities and pipeline companies for coating at "hot spots," road crossings, for valves, joints, meters, drips; for patching and for waterproofing concrete regulator pits.

•

Write for bulletin containing complete technical specifications, chemical and electrical properties and application information. Ask for the Roskote special trial order offer.

ROYSTON
LABORATORIES, INC.,
BLAWNOX, PA.

MANUFACTURERS OF QUALITY INDUSTRIAL COATINGS RESISTANT TO CORROSION BY ACIDS, ALKALIES, ELECTROLYSIS, HEAT, MOISTURE AND WEATHER.

H. C. Price Company Advances Three Executives

Promotion of three officials of H. C. Price Company, pipe line constructors of Bartlesville, Oklahoma, has been announced by Harold C. Price, president.

John M. Thomas, manager of the pipe line division, has been named a vice president; Elmer L. Gallery, formerly secretary-treasurer, has been advanced to the position of vice president and treasurer, and John P. Overton, assistant treasurer, has been promoted to secretary of the company.

Thomas has been associated with H. C. Price Company since 1937. Gallery and Overton joined the organization in February, 1946. All three men are in the Bartlesville office.

All Sun-Owned Pipe Lines Merged

Merging of all Sun-owned pipe line companies into Sun Pipe Line Company of Pennsylvania is announced by Robert G. Dunlop, president of Sun Oil Company.

The move, made for greater efficiency and co-ordination of operations, will not result in any material transfer of personnel, Dunlop said.

W. C. Kinsolving, who has been president of Sun's pipe line subsidiaries, heads Sun Pipe Line Company. Consolidation was effective December 31, 1951.

The companies merged to form Sun Pipe Line Company of Pennsylvania are Susquehanna Pipe Line Company and Sun Pipe Line Company (Texas).

Total length of these lines is 2427 miles, including 1395 miles of crude oil lines and 1032 miles of lines used in transporting refined products.

Sun Pipe Line Company also has taken over Sun Oil Company's interest in the 1000-mile Mid-Valley Pipeline Company and the 600-mile West Texas-Gulf Pipe Line Company.

Two main departments are set up in the new company—crude lines and product lines—and each will be headed by the men who were in charge of the merged companies.

Hill Sanders, of Beaumont, will be vice president and general manager of the crude lines department, with S. E. Ogle as a vice president and chief engineer.

In Philadelphia, B. K. Morse will be vice president and general manager of the product lines department. J. E. Ford also will be a vice president in this department.

Other officers include W. F. Leopold, Philadelphia, secretary; C. F. Heidrick, Beaumont, assistant secretary; J. B. Moffett, Philadelphia, assistant secretary; F. B. Ackerman, Beaumont, assistant secretary; A. H. Russell, Philadelphia, treasurer; R. W. Bowers, Philadelphia, assistant treasurer; S. C. Shockley, Beaumont, assistant treasurer and assistant secretary, and W. F. Yorty, Philadelphia, comptroller.

Serving with Kinsolving on the board of directors will be Sanders, Ogle, and Heidrick from Beaumont and Morse, Yorty, and Leopold from Philadelphia, Pennsylvania.

Parsons Announces Two New Trenchliners

With extensive field tests completed, Parsons Company of Newton, Iowa, has begun full scale production on two new models of Trenchliners. Both are full crawler mounted, wheel-type machines: Special pipeline Model 215, and drainage and utility Model 202.

With a choice of two standard make 55-hp diesel engines, the pipe line Model 215 is equipped with 6 digging wheel speeds up to 11.2 rpm; 30 digging feeds from 6.2 in. to 18.5 ft per min.; 9 trenching widths from 13 to 31 in. wide, and up to 6 ft deep. Standard-make, tractor-type crawlers are equipped with lug-type shoes, 18-in. treads. Ground bearing pressure is approximately 6 psi.

Other Model 215 features include: Friction clutch control of digging wheel, self-sharpening "Tap-In" digging teeth, shiftable and reversible belt conveyor for discharging spoil on either side of machine.

Parsons companion Model 202 incorporates many special features for high-speed production on drainage, irrigation, municipal, and utility-type trenching projects: Choice of either 52-hp gasoline or 55-hp diesel engine, 16 or 20 in. crawler treads, easily changed bucket fronts with cutting lips or "Tap-In" teeth, and optional tile laying box and chute.

Additional information and specifications on both new models may be obtained by contacting any Parsons Trenchliner distributor, or by writing direct to the Parsons Company of Newton, Iowa. Parsons is a subsidiary of the Koehring Company, Milwaukee.

Program Approved For Gas Measurement Course

The general committee of the Southwestern Gas Measurement Short Course met in Houston, Texas, on January 11, to work on plans for the 27th annual course, which will be held at the University of Oklahoma, Norman, Oklahoma, April 8, 9, and 10.

It is the aim and purpose of the Gas Measurement Short Course to provide through the cooperation of the university, the various associations and commissions, gas, gasoline and oil companies, a means whereby the men in the industry may get together to study problems pertaining to the measurement and regulation of dry and casinghead gas. It is hoped, thereby, to increase the accuracy of measurement and the efficiency of regulation to the end that the public may be better served, the dealings between buyer and seller put on an increasingly accurate and equitable basis, and that correct information regarding the engineering and practical problems involved be disseminated among the men in the industry.

The chairman of the general committee, J. L. Griffin, Northern Natural Gas Company, Omaha, Nebraska, reviewed the past activities of the committee for the benefit of the new members, then called on the chairman of the program committee, T. S. Whitis, West Texas Gas Company, Lubbock, Texas, for a progress report. Whitis submitted a tentative program, which after a few minor changes, was approved. Approximately 60 qualified persons will conduct the large number of diversified classes that will be held during the short course.

Other chairmen who reported were:

Local arrangements, Dean W. H. Carson, University of Oklahoma, Norman.

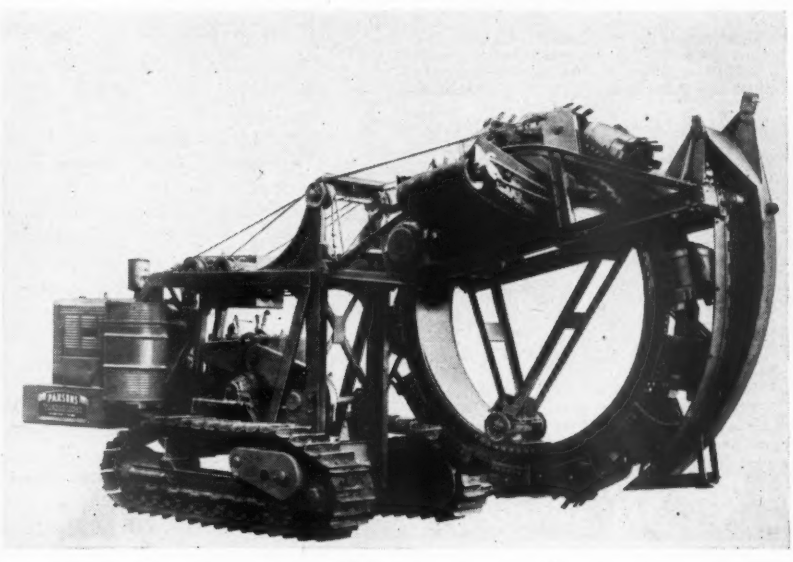
Publicity and registration, by W. H. Carson for Miss Kate A. Niblack, Oklahoma Utilities Association.

Exhibits, R. S. Peace, Jr., Southern Natural Gas Company, Birmingham.

Publications, K. R. Tibbets, Warren Petroleum Company, Tulsa, Oklahoma.

Model 202 Trenchliner

Model 215 Trenchliner of Parsons Company, Newton, Iowa.



EXPANSIBLE INTERNAL PIPELINE CLEANER

Designed and Proven by Pipeline Men

All sizes 6" to 30"

UNLESS YOU ARE USING THE EXPANSIBLE CLEANING MACHINE, YOUR LINES ARE NOT BEING THOROUGHLY CLEANED.

EXPANDS for constant pressure on all sides. Compensates for brush wear.

FLEXIBLE to eliminate stoppage on bends, drops, etc. Can traverse 90° 1½ radius tube turns.

EFFICIENT cleaning pays off in increased gas volume.

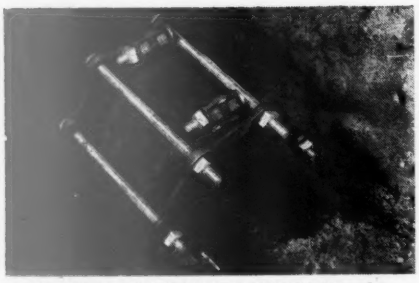
CLEANER PIPELINES CO.

1900 Armour Road, North Kansas City 16, Missouri

REPAIR LEAKS

QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.



SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY

SOUTH BEND 21, INDIANA, U. S. A.

A. L. Forbes, Jr., left, with L. H. Favrot, taken at Pipe Line Contractors Association held last month in Houston, Texas at the Shamrock Hotel.

Industry Shocked at Death of A. L. Forbes, Jr.

A. L. Forbes, Jr., president of Associated Pipe Line Contractors, Inc., Houston, Texas, died of a heart attack January 10 while on a plane en route from Houston to Bangor, Maine, on a business trip. Only the day before he had been elected president of the Pipe Line Contractors Association at its annual convention held at The Shamrock Hotel in Houston.

Forbes was born December 3, 1898, in Galveston, Texas, but was reared in Houston. He was graduated from Texas A. & M. College in 1921 with a degree in civil engineering. For nine years he worked for several oil companies in the Houston area, then joined the staff of El Paso Natural Gas Company, El Paso, Texas. From 1930 to 1943 he was chief engineer, general superintendent, and vice president of that company. From the latter part of 1943 until June, 1945, he was vice president and general manager of the Pressure Welding Company, a wholly owned subsidiary of the El Paso Natural Gas Company.

In July, 1945, Forbes resigned to become a partner in a pipe line construction company known as Associated Contractors and Engineers, a partnership composed of L. H. Favrot, George H. Peterkin, J. W. Sharman, Earl Allen and himself. This partnership functioned until February, 1946, at which time Forbes and Allen formed a partnership under the same name. In 1947 the business was incorporated and in 1949 the name of the corporation was changed to Associated Pipe Line Contractors, Inc.

Forbes is survived by his widow, Corinne Mayfield Forbes, Houston; a son, A. L. Forbes, III, 23; and a daughter, Patricia, 20.

The accompanying picture shows Forbes with L. H. Favrot and is probably his last photograph. It was taken on January 9 after the annual banquet of the Pipe Line Contractors Association. Favrot was the outgoing and Forbes the incoming president of the association.

New Pipe Line Pumps Nickel Ore Concentrate

A 7½-mile pipe line has been completed by The International Nickel Company of Canada, Ltd., through which the bulk concentrate from 3,650,000 tons of nickel-copper ore is being pumped annually from its newly built Creighton concentrator to its reduction plants at Copper Cliff, Ontario. It is believed that never before has concentrate been carried by pipe line in such quantity over such a distance.

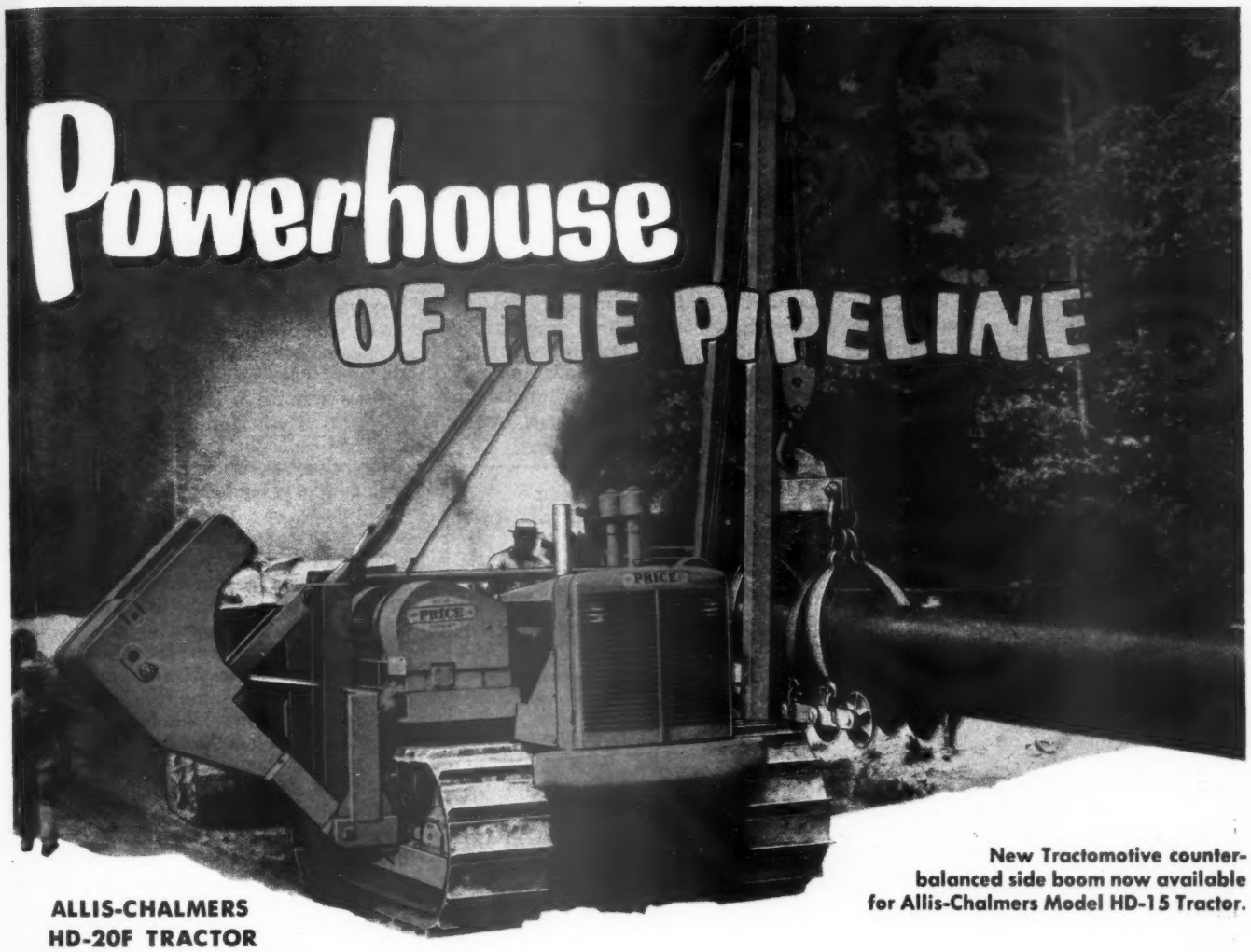
In making the announcement R. L. Beattie, vice president and general manager, said: "The pipe line reduces the time required to transform nickel ore into refined nickel. Further, the economies resulting from pipe line transportation, together with other economies, have made possible the working of lower-grade Creighton ore, which is now contributing to the availability of nickel for the defense production needs of the free world."

Part of International Nickel's $130,000,000 program of underground mine expansion, the pipe line artery has been integrated into an elaborate pipe line system that also carries tailing, or waste material, from both Creighton and Copper Cliff to a disposal area midway between the two plants.

Racker Moves Office

Joseph Racker, president of Joseph Racker Company, communications consultants, announces that the company's address now is 140 Nassau Street, New York 38, New York. The former address was 67 West 44th Street in New York.

Powerhouse OF THE PIPELINE



ALLIS-CHALMERS
HD-20F TRACTOR
175 net engine hp. • 43,500 lb.

New Tractomotive counter-balanced side boom now available for Allis-Chalmers Model HD-15 Tractor.

Allis-Chalmers HD-20 Torque Converter Tractor with Tractomotive Side Boom

Here's the new, more powerful tractor-side boom combination that is setting new production records even under toughest conditions. Words cannot fully describe its outstanding performance ability nor its safe operation, but a glance at the following exclusive advantages will help explain why this unit is fast becoming the standard of comparison.

HYDRAULIC TORQUE CONVERTER DRIVE provides smooth, liquid-cushioned power through boom and tracks, eliminates most of the shifting, permits operator to concentrate on boom work and control signals. With full horsepower available at even 1/10 of a mile per hour — the HD-20 matches its speed perfectly to slow-paced equipment such as doping and wrapping machines.

MAXIMUM FLOTATION AND CLEARANCE. In muddy bottoms the torque converter eases the tractor into motion so smoothly there is little tendency for tracks to dig in. With extra traction and clearance, you have the assurance that the "20" will get through.

EASY TO SERVICE. Truck wheels, support rollers, and front idlers require lubrication only once every 1,000 hours. No lubrication points underneath the tractor. Unit construction means that major assemblies can be removed without disturbing companion groups.

EASY TO OPERATE. Hydraulic finger-tip steering, self-energizing brakes, cushioned seats, padded arm rests, and liquid cushioning of the hydraulic torque converter give maximum operator comfort.

and matched to this Powerhouse Tractor—

THE HEAVY-DUTY TRACTOMOTIVE SIDE BOOM

- 124,000-lb. Lifting Capacity at 4-ft. Overhang
- Convenient, Positive Controls
- Drop-proof, Extendable Counterweights
- Internal Expanding Brakes
- Pin-Connected Sectional Frame
- 20-ft. Box Section Boom
- Constant Mesh Transmission

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Centriline Process Territory to Pipelinings, Inc.

Pipe Linings, Inc., Los Angeles, California, a subsidiary of American Pipe and Construction Company, is now in a position to handle the relining of cast-iron and steel pipe lines in the western states and British Columbia, using the Centriline process for pipe lines 16 in. to 144 in. in diam, it has been announced. Pipe Linings, Inc., will continue to offer its own process for relining pipe lines 4 in. to 16 in. in diam.

In obtaining this territory for the Centriline process, Pipe Linings takes over all equipment and machinery of the Centriline Division, American Pipe and Construction Company, former licensee.

As a result of the new arrangement Pipe Linings, Inc., now offers complete facilities for relining water, oil, and gas cast-iron or steel pipe lines from 4 in. to 144 in. in diam. With both the Tate process and the Centriline process, all tuberculation and incrustation is removed from the interior of old pipe lines and a new cement mortar lining is applied, giving protection against discoloration, contamination, and corrosion, improving flow coefficients, preventing leaks, and reducing maintenance and pumping costs. With both processes, all cleaning and relining is accomplished with only the momentary interruption to service required by the installation of temporary bypass lines, it is stated.

PEWTHERS' "EARTHRIPPER"

OPENS THE EARTH LIKE A ZIPPER!

ECONOMICAL... Pewthers' EARTHRIPPER saves money three ways! It costs less—it's speedy operation saves labor costs . . . and standardization of automotive parts cuts down maintenance costs. Construction engineers who use the Pewthers' EARTHRIPPER have found that it costs only 4c a foot to operate. This low cost covers initial investment, depreciation, operation, maintenance, and labor over a three-year period! With an EARTHRIPPER, one man can handle your ditching problems, from driving the machine to the ditch site to lowering the boom and opening the earth at a maximum rate of twenty feet a minute! Because all gears run in oil, the EARTHRIPPER can be used for years with few replacements of parts. If you want to save time and money, invest in an EARTHRIPPER today.

MOBILE... The EARTHRIPPER is versatile because it is mobile. On the highway its speed is the speed of the truck. The raised boom clears telephone wires and tree branches, making transit easy and speedy, even in heavy city traffic. The EARTHRIPPER digs vertical ditches in any kind of terrain under almost any digging conditions. On slopes the frame levels. While the tires follow the contour of the earth, the ditcher digs a vertical ditch! If you need a ditcher for large or small ditching jobs, the EARTHRIPPER can solve your problems.

EFFICIENT... For straight, clean ditching, the answer is Pewthers' EARTHRIPPER. This new, unique ditcher offers a completely different design. It is the first ditcher to be built into a truck. Bucket design saves time because there is no loss of time in cleaning. Bottom of each bucket forms the top of the preceding one. The buckets separate as they go over the top sprocket, throwing the dirt onto the conveyor belt. Conveyor belts throw the dirt on either side of the ditch and can be reversed on a moment's notice. In competition the EARTHRIPPER digs straight ditches with clean sides . . . in record time.

Pewthers' "EARTHRIPPER" is the only ditcher built into a truck. This means *one man* can handle your ditching job, from driving the machine to the ditch site to opening the earth to a maximum depth of five feet. The EARTHRIPPER is particularly suited for gas lines, extensions and house-to-street service lines. Utility ditching requiring ditches 10", 14", or 18" wide are duck soup to this new, *different* Pewthers' ditcher.

Send for the folder on the new Pewthers' ditcher, the EARTHRIPPER. Learn for yourself how the EARTHRIPPER can save time and money on any small ditching job! Ask for a demonstration before purchase . . . at any point in the United States!

I want the new folder on the Pewthers' "EARTHRIPPER."

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

I saw this ad in the above magazine.

PEWTHERS DITCHER COMPANY

2323 CLAIBORNE AVE. • SHREVEPORT, LOUISIANA

Committee Appointed To Review Par Plan

A new general committee of the American Gas Association has been appointed to review the Promotion, Advertising and Research (PAR) Plan of the association, it is announced by George F. Mitchell, president of AGA, and president of The Peoples Gas Light and Coke Company, Chicago. The new committee, appointed at the suggestion of the current PAR committee, will evaluate experience with the PAR Plan to date, and will make recommendations to the executive board of AGA concerning any necessary revisions. A similar review was made in 1947.

R. J. Rutherford, president, Worcester Gas Light Company, Worcester, Massachusetts, is chairman of the new committee. Members include: M. A. Abernathy, vice president, United Gas Pipe Line Company, Shreveport, Louisiana; Ernest R. Acker, president, Central Hudson Gas and Electric Corporation, Poughkeepsie, New York; Stuart M. Crocker, chairman of the board, Columbia Gas System, Inc., New York, New York; Charles H. Gueffroy, president, Portland Gas and Coke Company, Portland, Oregon; John L. Haley, vice president, Niagara Mohawk Power Corporation, Syracuse, New York, and Robert W. Hendee, president, Colorado Interstate Gas Company, Colorado Springs, Colorado.

Also appointed to the committee were: W. M. Jacobs, vice president, Southern California Gas Company, Los Angeles, California; Frank H. Lerch, Jr., chairman of the board, Consolidated Natural Gas Company, New York; J. F. Merriam, president, Northern Natural Gas Company, Omaha, Nebraska; Dean H. Mitchell, president, Northern Indiana Public Service Company, Hammond, Indiana; James F. Oates, Jr., chairman, The Peoples Gas Light and Coke Company, Chicago, Illinois; Albert B. Paterson, chairman of the board, New Orleans Public Service, Inc., New Orleans, Louisiana; Hudson W. Reed, president, The Philadelphia Gas Works Company, Philadelphia, Pennsylvania; J. French Robinson, president, Consolidated Natural Gas Company, New York, New York; Rock G. Taber, president, Atlanta Gas Light Company, Atlanta, Georgia, and Edward J. Tucker, vice president and general manager, The Consumers' Gas Company of Toronto, Canada.

Eugene D. Milener, American Gas Association, will serve as secretary of the committee.

Buchanan Heads FPC

Commissioner Thomas C. Buchanan of Pennsylvania has been made chairman of the Federal Power Commission. The chairmanship was vacated October 1, 1951, by the resignation of Mon C. Wallgren. Buchanan has been a member of FPC since July 14, 1948, and served as vice chairman from May, 1950, until the end of 1951.

Henry C. Roemer Heads Federal Telephone

Henry C. Roemer, executive vice president of Federal Telephone and Radio Corporation, Clifton, New Jersey, since September, 1950, has been elected president of that manufacturing associate of the International Telephone and Telegraph Corporation. Roemer, who directed Federal's activities during World War II, assumes the presidency of the company during another national crisis calling for his wide experience in handling problems arising out of the defense effort.

Henry C. Roemer

Roemer has been prominent in the development of Federal since 1940. It was under his guidance as executive vice president that the company's facilities were expanded to help meet the nation's requirements for communication and other equipment during the years of the last war. The end of that conflict found Federal with 58 locations in and around Newark devoted to manufacture for the armed forces.

At the same time, Roemer was active in the planning and construction of Federal's plant at Clifton and the Federal Telecommunication Laboratories, Inc., Nutley. With Col. Sosthenes Behn he broke ground for the plant in February, of 1943, and in the following year he turned the first spade of earth for the laboratories. The latter, with its 300 ft microwave tower, "a laboratory in the sky", and Federal's plant with its million square foot production area, continue to serve the nation's defense and contribute to the prosperity of northern New Jersey.

In addition to production for the military, the manufacture by Federal of equipment and products for wide commercial application also is being emphasized by Roemer. These include Pulse Time Modulation Microwave radio relay systems many of which are being installed for pipe lines, utilities, telephone, and other industries; selenium rectifiers, first introduced by Federal; high frequency cable; mobile radio, for both railroad and vehicular use; transmitting and industrial vacuum tubes; television picture tubes; telephone and telegraph carrier equipment; central office telephone equipment and other communication and associated items.

Joining the IT&T in 1927, Roemer was made chief accountant in 1930 and assistant comptroller in 1932. From 1933 to 1938 he was in charge of accounting and finance for IT&T manufacturing associates in Great Britain and the continent of Europe, and in 1939 also served in Cuba. He was elected a director of IT&T in 1943; a vice president in 1944 and comptroller in 1946. Since 1940 he has been a director and vice president of Federal.

Application to Sell Gas Line Withdrawn

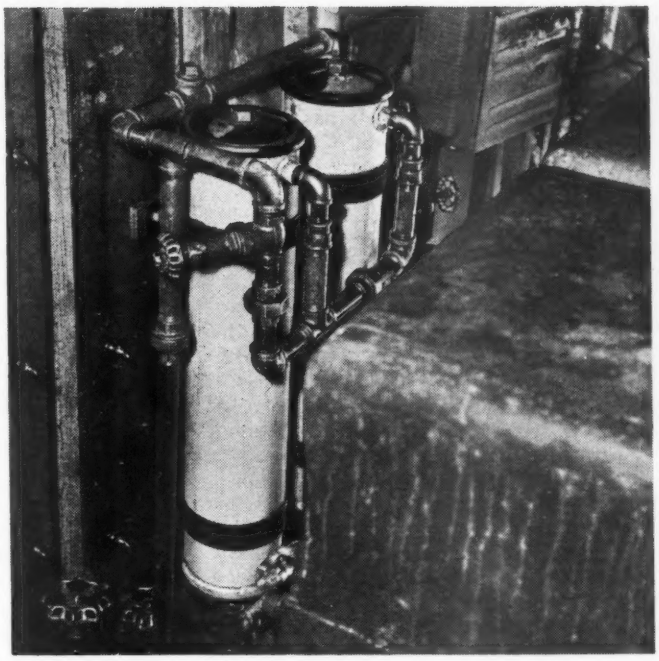
The Federal Power Commission has permitted the withdrawal of applications filed in May, 1950, in connection with the proposed sale by Virginia Gas Transmission Corporation, of Charleston, West Virginia, of a 30-mile lateral natural gas pipe line to Lynchburg Pipe Line Company, of Lynchburg, Virginia.

The two companies, in a petition filed with the FPC last month, said that they wanted to withdraw their applications because the proposed purchase of the line by Lynchburg would not be feasible in view of the short supply of gas currently available to Virginia Gas Transmission, preventing the serving of new markets along the lateral.

Pipe Line Applications Consolidated

FPC has consolidated applications of five pipe line companies with the proceedings involving the proposal of Texas Gas Transmission Corporation, Owensboro, Kentucky, to carry out an expansion program to supply additional natural gas to present market areas.

Applications consolidated with Texas Gas are Ohio River Pipeline Corporation, Indianapolis; Louisville, Kentucky, Gas and Electric Company; Louisiana Natural Gas Corporation and Texas Northern Gas Corporation, Lake Charles, Louisiana, and United Gas Pipe Line, Shreveport, Louisiana.



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PIPE LINE PERSONALS

T. H. "Hedge" Edmonds has joined Mid-States Construction Company, Mount Vernon, Illinois, as vice president in charge of field operations.

Eugene M. Henderson has resigned as chief engineer of Interstate Oil Pipe Line Company to become coordination assistant in the office of the coordinator of transportation activities of Standard Oil Company (New Jersey), with headquarters in New York City. In his new capacity Henderson's duties will be concerned with construction and maintenance projects and economic studies pertaining to the world-wide transportation programs of Standard Oil Company (New Jersey).

Henderson, an engineering graduate of the University of Oklahoma, was employed by Oklahoma Pipe Line Company, the predecessor of Interstate Oil Pipe Line Company, in Tulsa, Oklahoma, July, 1935. He became chief engineer of Interstate's northern division in September, 1945, and chief engineer of its consolidated engineering department in June, 1949.

E. C. Mishou, former division chief engineer of Interstate's southern division, who has been on a temporary assignment with Standard Oil Company (New Jersey) in New York City for the last eight months, has been named to fill the position of chief engineer. **Norman E. Tilden,** Shreveport, who has been acting assistant chief engineer since May, 1951, has been formally named to that post.

Mishou joined Interstate as safety engineer, with headquarters in Tulsa, in 1945, after two years with Ajax Pipe Line Corporation as an engineer. In mid-1947, he transferred to Shreveport as assistant division chief engineer of the southern division. He was promoted to division chief engineer in October, 1948, and held that post until beginning his recent assignment in New York. Born in Pueblo, Colorado, Mishou attended Columbia University in New York City and later received his BS degree in petroleum engineering from the University of Kansas.

Tilden joined Oklahoma Pipe Line Company in July, 1942, as junior engineer and a short time later was made district engineer. From June, 1943, to July, 1947, he was with Dominican Seaboard Oil Company in the Dominican Republic. He returned to Interstate's engineering department in July, 1947, as an engineer. For some time before Interstate's headquarters were moved to Shreveport from Tulsa in the recent consolidation, Tilden was serving as head of the general engineering unit of the staff engineering department in Tulsa.

Ben O. Connel has been promoted from sub-foreman in the Safford, Arizona, district to foreman of the Phoenix transmission district by the El Paso Natural Gas Company.

George W. Oliver has been made Southwest Texas Division superintendent for Humble Pipe Line Company. He has been acting in that position since June, 1951.

Oliver joined the company in 1923 in Corsicana, and has been sent to various pipe line stations and offices throughout the state. His headquarters are now in Corpus Christi.

In other promotions announced by company officials, **Hickman E. Hensley** was named assistant division superintendent for West Texas. Hensley joined Humble in 1927 in Cisco and has recently been Odessa district superintendent. His new offices are in Midland.

Replacing Hensley in Odessa will be **P. Harold Yolland,** who was first employed by Humble in Webster in 1920. His last assignment was as assistant district superintendent in Pierce Junction.

Yolland's assistant is **Marvin E. Banks,** whose career with the company began in 1932 in Iowa Park. He had been acting district superintendent for several months before being officially appointed to the post.

Ray E. Cartmill has been named division right-of-way man for the Service Pipe Line Company in Wyoming. He replaces **John B. "Cap" Seaton** who died November 19 after a heart attack in Williston, North Dakota.

In his new position Cartmill will represent the company in all matters related to pipe line right-of-way in Wyoming.

Cartmill first was employed by the company in 1940 in a line maintenance crew, later advancing to the right-of-way department. He was stationed at Hays, Kansas, before transferring to Casper.

E. O. Perkins has been named general manager of the supply and distribution department of The Texas Company, and **J. V. C. Malcolmson** has been appointed to succeed him as assistant general manager of Texaco's marine department.

Perkins began working for The Texas Company in 1920 as a stenographer at its Port Arthur, Texas, refinery. He held various positions in the refining department and was transferred to the marine department as assistant general manager in 1948. Malcolmson joined the company in 1942 in the construction and repair division of the marine department, and became manager of that division in 1948.

George G. Hughes, head of the research unit of Interstate Oil Pipe Line Company's engineering department, Shreveport, Louisiana, has been granted a year's leave of absence to accept a position with the Petroleum Administration for Defense in Washington, D. C. Hughes was employed as an engineer by Interstate when he returned from service in November, 1945. Prior to that time he had been engaged in geophysical work in Louisiana and Mississippi.

R. L. Council has been promoted to chief dispatcher of Magnolia Pipe Line Company with headquarters at Dallas. He replaced **F. P. Childress** who retired after more than 36 years' service.

C. A. Eaton, Jr., has been promoted to assistant chief dispatcher.

W. G. McLarry, formerly telephone engineer, has been placed in charge of construction and maintenance of telephone facilities with headquarters at Dallas. He replaces **J. W. Hale** who has retired.

M. E. Bay has been promoted to district superintendent of Magnolia Pipe Line Company's North Texas district with headquarters at Wichita Falls, Texas. He replaces **H. F. Smith** who retired from the company January 1.

B. B. Balke has been made chief gager of the northern division with headquarters at Healdton, Oklahoma. He replaces **E. M. Phillips** of Oklahoma City who retired. **J. R. Dean** has been promoted to chief gager of the western division with headquarters at Midland, Texas. He replaces Balke.

C. F. Combrink has been promoted from field maintenance mechanic to mechanical maintenance supervisor at Cushing, Oklahoma, by Shell Pipe Line Corporation.

H. L. Nixon, field gager at Goldsmith, Texas, has been made assistant district gager at Roberts.

Lee A. Christiansen has been appointed assistant general traffic manager of Sun Oil Company. Christiansen has been active in the transportation field for 20 years and had served as an assistant traffic manager for Sun since July, 1950. He is a graduate of the Wharton School of Finance and Commerce, University of Pennsylvania.

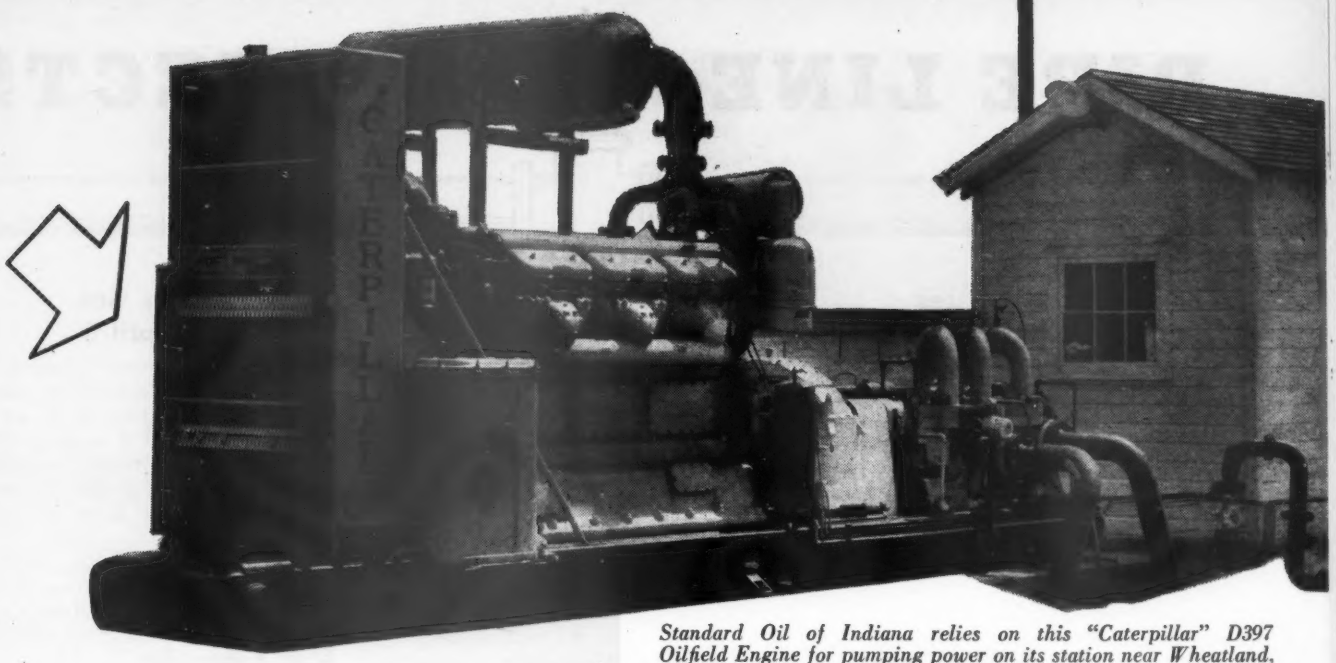
H. J. Amend has been elected auditor of the Sinclair Pipe Line Company, Independence, Kansas, to succeed **Allen Moffitt,** who retired at the beginning of the year under Sinclair's employee's retirement plan.

Moffitt entered the service of the Sinclair organization at Houston, Texas, on July 15, 1918. He was stationed at Houston until July, 1931, when he was transferred to Tulsa. On May 3, 1932, he was transferred to Independence as chief clerk for the Sinclair Refining Company, pipe line department. In 1946, he was elected auditor.

Amend entered the service of the old Prairie Pipe Line Company in 1917, and has been in continuous service of the Prairie and Sinclair organizations since that time. He has been assistant auditor since 1948.

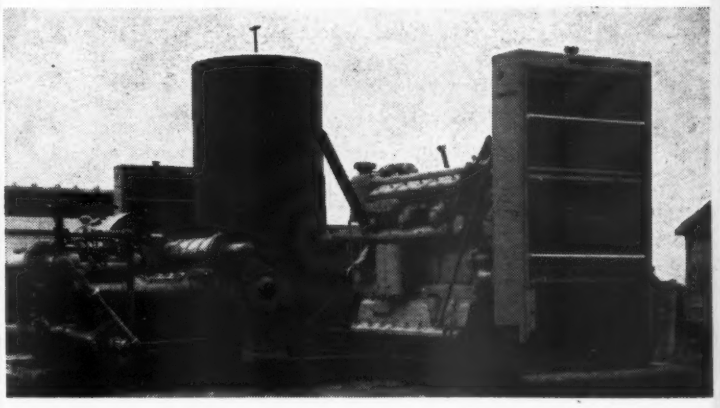
A. L. Strain has been elevated to the position of assistant auditor. Strain entered the service of Prairie in 1916, and has been in continuous service of Prairie and Sinclair organization since that time.

A. H. Gibson of the company's Kansas City division office, has been appointed manager of the newly created personnel department of the company.



Standard Oil of Indiana relies on this "Caterpillar" D397 Oilfield Engine for pumping power on its station near Wheatland, Wyoming. Capacity of the station's Byron-Jackson pump with Farrel Birmingham speed increaser is 18,800 barrels per day.

They've got all it takes for pipe-line pumping



Interprovincial Pipe Line Co. uses these two "Caterpillar" D386 Oilfield Engines to power its pumping station in Edmonton, Alberta. The operator states that these engines are proving to be very satisfactory.

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PIPE LINE PROJECTS

Tennessee Gas Proposes Laying 895-Mile Line

The Tennessee Gas Transmission Company on January 18 requested approval in a petition filed with the Federal Power Commission in Washington for a proposed $128,216,000 expansion program, which would increase daily capacity of its natural gas transmission system from its presently authorized 1,310,000,000 cu ft to 1,515,000,000 cu ft.

Peak day deliverability would be increased 200,000,000 additional cu ft, to 1,715,000,000 cu ft through proposed construction by Tennessee Gas and the United Natural Gas Company of Oil City, Pennsylvania, of an underground storage area in the Hebron field of Potter County, Pennsylvania.

The company also proposed construction of 591 miles of pipe line parallel to its existing system, a new 304-mile pipe line from the existing system near Mercer, Pennsylvania, through the Hebron field to the existing system at Utica, New York, and new compressor units with 165,000 hp to be installed at new and existing compressor stations.

The 205,000,000 cu ft increased daily would be used to furnish increased supplies to the company's present customers, including 65,000,000 additional cu ft daily to Northeastern Gas Transmission Company of Springfield, Massachusetts, company subsidiary that is supplying gas to New England.

The FPC held hearings in 1951 on a company application to build facilities similar to those for which authority is now sought, and granted part of the application; but the part denied made the project unfeasible to the company, which now proffers new evidence on the controversial part.

Work on Trans Mountain Line to Begin in Spring

Contracts for laying the pipe of Trans Mountain Oil Pipe Line Company's $80,000,000, 693-mile pipe line between Edmonton, Alberta, and Vancouver, British Columbia, have been awarded to Mannix, Ltd., of Calgary, Alberta, and Comstock Midwestern, Ltd., of Toronto, Ontario, Van W. Rosendahl, president of Canadian Bechtel, Ltd., as agent for Trans Mountain, has announced.

The Board of Transport Commissioners for Canada granted, in December, Trans Mountain the necessary permit to construct the first crude oil pipe line between Alberta and the Pacific Coast. The pipe line will be built of 24-in. diam pipe. At the start two pump stations will be constructed providing an initial capacity of 75,000 bbl per day. Ultimate capacity will be 200,000 bbl per day, made possible by the construction of additional pump stations.

"Work on the right-of-way clearing will start as early in 1952 as weather permits," Rosendahl stated. "Pipe laying, provided the necessary priorities for the required pipe are obtained, will begin about June 1, 1952. The actual laying of the pipe in western Alberta and in most sections of British Columbia will be limited to five or six months during the summer and fall seasons because pipe laying operations, and particularly coating, wrapping, and welding, require dry weather and moderate temperatures. Plans provide for four pipe laying gangs working during the first construction season and five gangs during 1953.

"Under the contracts let to Mannix, Ltd., and Comstock Midwestern, Ltd., Mannix will construct approximately 221 miles in the center of the line, while Comstock Midwestern will construct approximately 472 miles on the eastern and western portions of the line."

Contracts covering the pump stations and tank farms will be awarded at a later date, according to Rosendahl.

Canadian Bechtel, Ltd., as agent for Trans Mountain Oil Pipe Line Company, will supervise construction of the line. The Bechtel organization also will engineer the pipe line, the pump stations, and other appurtenances. Canadian Bechtel, Ltd., is a subsidiary of Bechtel Corporation.

Final Authorization to Columbia Subsidiaries

The Federal Power Commission has granted final authorization to two subsidiaries of The Columbia Gas System, Inc., for the construction of natural gas pipe line facilities in Maryland, Pennsylvania, and West Virginia.

The two subsidiaries are the Cumberland and Allegheny Gas Company and The Manufacturers Light and Heat Company, both of Pittsburgh, Pennsylvania. Estimated cost of the facilities is $2,433,137 for Cumberland and $11,100 for Manufacturers. The commission previously granted temporary authorizations to both companies for their respective construction programs.

Cumberland's construction program includes a total of about 57 miles of new pipe line in Maryland and West Virginia, two new compressor stations with a total capacity of 2080 hp, and the conversion of an existing station to two-stage operation. Manufacturers received authorization for 100 ft of line in Pennsylvania and the exchange of a compressor cylinder at one of its stations in West Virginia for a similar cylinder at one of Cumberland's stations.

FPC Postpones Gas Hearing to April 8

The Federal Power Commission hearing previously scheduled to start January 9 in Washington, D. C., on six applications in which it is proposed to obtain natural gas supplies from subsidiary companies of The Columbia Gas System, Inc., has been postponed to April 8.

The postponement was requested by three Columbia subsidiaries—The Manufacturers Light and Heat Company, Home Gas Company, and Atlantic Seaboard Corporation.

Hearings on the applications were held last April, and in December the Commission reopened the proceedings to take additional evidence bearing upon the current estimated gas requirements and the gas supply situation of the Columbia system. The January 9 hearing was scheduled at that time.

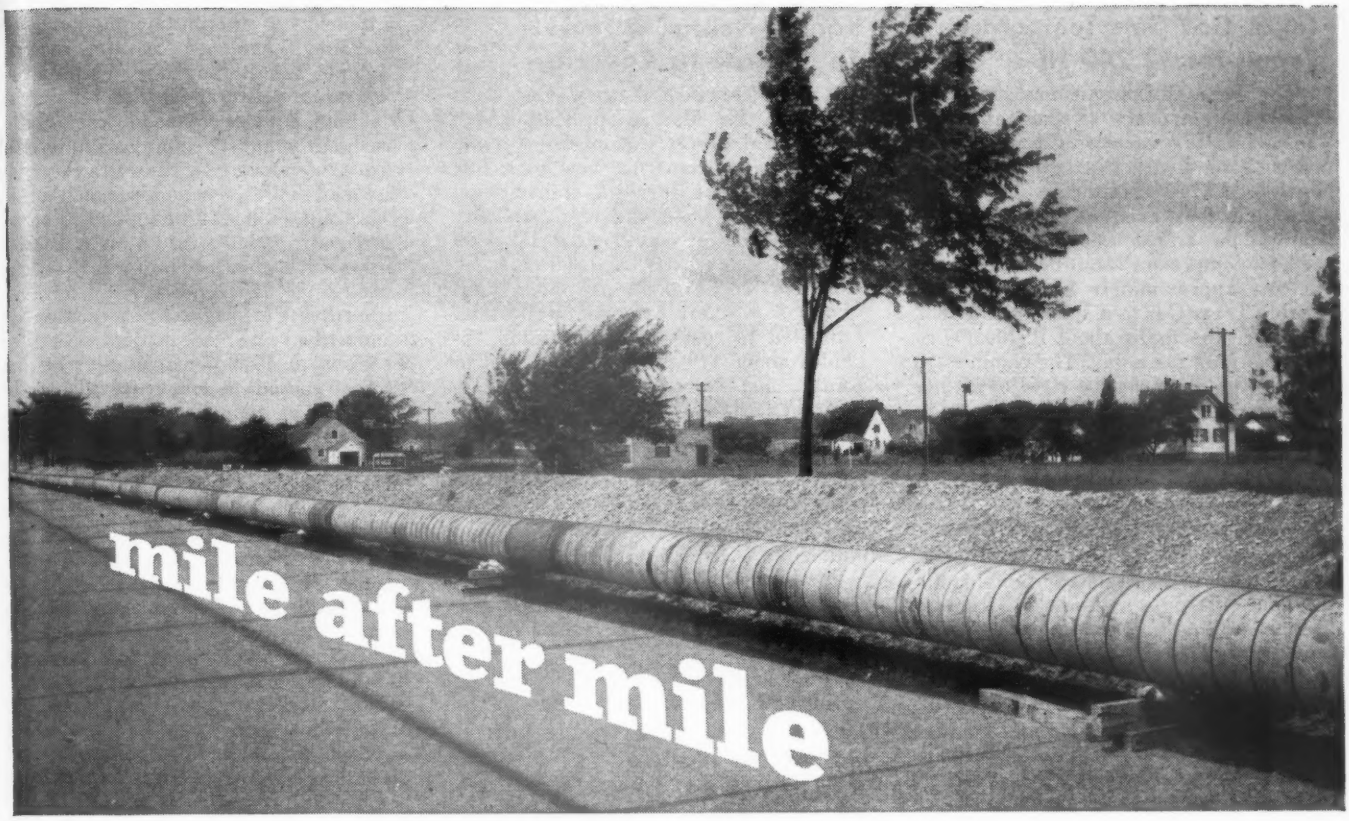
The applications are by New River Gas Company, of Radford, Virginia, which is proposing to build a line to serve five cities in southwestern Virginia and is seeking gas from Atlantic Seaboard Corporation; Warwick Gas Corporation, of Flordia, New York, and Crystal City Gas Company, of Corning, New York, which have asked the FPC to direct Home Gas Company to supply them with gas; Citizens Gas Company, of Stroudsburg, Pennsylvania, and Bangor Gas Company, of Bangor, Pennsylvania, which are seeking gas from The Manufacturers Light and Heat Company; and Pen Argyl Gas Company, of Pen Argyl, Pennsylvania, which would get gas indirectly from Manufacturers through a connection with Bangor Gas Company's system.

Ohio Fuel Gas Company Proposes Storage Line

The Ohio Fuel Gas Company, of Columbus, Ohio, has filed an application with the Federal Power Commission for authorization to construct and operate a 31.2-mile pipe line in central Ohio for the transportation of natural gas to underground storage and market areas.

The proposed line, estimated to cost $1,440,000, would extend from the company's Treat compressor station in Licking County to its Weaver storage compressor station in Richland County.

The application says that the line would augment existing facilities for the transportation of gas to underground storage areas, thus helping the company meet its 1952 storage input schedule. The proposed new facilities also would be used to help transport gas from underground storage to markets in winter months, the application states.



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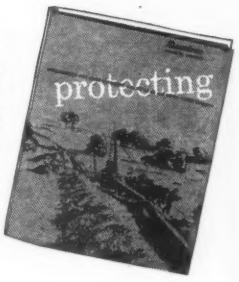

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Texas Gas Gets Temporary Permit for 12,240 Hp

The Federal Power Commission has granted temporary authorization to Texas Gas Transmission Corporation, of Owensboro, Kentucky, to construct and operate 12,240 compressor hp at one new and four existing stations on its natural gas transmission system.

The compressor facilities, estimated to cost approximately $2,992,760, will enable Texas Gas to increase its off-peak delivery capacity by about 12,700,000 cu ft of natural gas a day. The commission said it was reserving the right to modify the proposed disposition of this additional gas after opportunity is given to all interested parties to be heard on the matter.

Under the temporary authorization, Texas Gas will build a new 5280-hp compressor station near Madison, Indiana, and will install additional units at four existing stations at Kenton, Tennessee, and Calvert City, Slaughters, and Hardinsburg, Kentucky. The capacity of these four stations which now totals 24,300 hp, will be increased by 6960 hp.

The construction of the 12,240 hp is part of an overall construction program now pending before the commission. In that application Texas Gas is proposing to install a total of 26,860 hp in compressor capacity and to build about 407 miles of pipe line.

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Kansas-Nebraska Seeks To Increase Its Capacity

Kansas-Nebraska Natural Gas Company, Inc., has filed an application with the Federal Power Commission for authorization to construct new pipe line facilities on its natural gas transmission system to increase the total capacity from the presently authorized 182,600,000 cu ft a day to 193,300,000 cu ft.

Kansas-Nebraska's proposed construction covered by this application, estimated to cost about $2,315,220, includes about 179 miles of pipe line in Kansas and Nebraska, the rearrangement of certain compressors, and stub lines and metering stations to serve new main line industrial customers. The company also is seeking authority to substitute 10¾-in. pipe for 8⅝-in. pipe on a 52-mile line in Nebraska previously authorized by the FPC.

Part of the new pipe line will replace sections of existing line, totaling about 93 miles, which is to be removed and salvaged.

The company's main office is in Phillipsburg, Kansas.

Northwest Natural Amends Application

Northwest Natural Gas Company has filed an amended application with the Federal Power Commission in connection with its proposal to build a natural gas transmission system in the Pacific Northwest to transport gas from Canada to markets in Idaho, Washington, and Oregon, with a portion to be returned to Canada for use in British Columbia.

The proposed pipe line system would have a maximum daily delivery capacity of 285,000,000 cu ft a day. Estimated total overall capital cost of the project, including gathering and transmission facilities in Canada, is $92,000,000.

The project would include 373 miles of 24-in. pipe from a point near Eastport, Idaho, to Monroe, Washington; 79 miles of 18-in. line from Monroe to the International Boundary near Lynden, Washington; 29 miles of 22-in. pipe from Monroe to a point near Seattle, Washington, and 164 miles of 20-in. pipe from near Seattle to Portland, Oregon. In addition, various lateral lines and four compressor stations with a total of 24,750 hp would be built.

The natural gas that Northwest proposes to import would be gathered in Alberta, Canada, by a subsidiary, Alberta Natural Gas Grid, Ltd. Another subsidiary, Alberta Natural Gas Company, would transport the gas in Canada. The gas would be drawn from the Pincher Creek, Princess-Patricia, Many Islands Lake, and Dunmore fields, all in Alberta. Northwest said that it, with its two subsidiaries, has an application pending with the Alberta Petroleum and Natural Gas Conservation Board for permission to remove the gas from the Province.

The application states that the proposed project would supply the gas requirements of distributing companies in Spokane, Wenatchee, Seattle, Tacoma, Olympia and Bellingham, Washington; Vancouver and Trail, British Columbia; Portland, Oregon; other towns in Idaho, Washington and Oregon; and industrial customers along the route of the pipe line and within economic reach of it. The proposed main-line industrial customers will include the Atomic Energy Commission plant at Hanford, Washington.

Northwest's original application in connection with the project was filed February 2, 1948. The company at that time proposed to construct a total of 756 miles of main line, various laterals, and four compressor stations with an aggregate installation of 28,500 hp. Maximum daily capacity would have been 209,000,000 cu ft.

The 1948 application estimated the cost of the transmission facilities in the United States at $38,431,000, whereas the amended application estimates the cost of this portion of the project at $50,200,000. The market areas proposed in both applications are similar.

Northwest Natural Gas Company was organized in 1946 for the purpose of constructing and operating the proposed pipe line system, and it presently has no existing properties used in the transportation of natural gas. Its principal place of business is in New York City.

New Company Seeks to Purchase Gas Facilities

Mississippi Valley Gas Company, of Jackson, Mississippi, has applied to the Federal Power Commission for authorization to acquire and operate pipe line facilities of Mississippi Power and Light Company, of Jackson, Mississippi, now being used by the latter company in the transmission and sale of natural gas in western Mississippi.

Mississippi Valley Gas is a new organization, organized primarily for the proposed acquisition and operation of the Mississippi Power facilities, and does not now own any natural gas properties.

The facilities which would be acquired include Mississippi Power's existing gas system in Adams, Attala, Bolivar, Carroll, Coahoma, De Soto, Grenada, Hinds, Holmes, LeFlore, Montgomery, Rankin, Sunflower, Tunica, Washington and Yazoo counties, Mississippi. In addition, the new company would operate existing systems which Mississippi Power now leases and operates in Humphreys, Leake, Sharkey, and Tate counties.

The system owned by Mississippi Power includes 1199 miles of 3-in. equivalent pipe line, and the systems which that company leases include about 242 miles of 3-in. equivalent pipe. The latter systems are leased by Mississippi Power from the Town of Carthage and the Bolivar, Deer Creek, Delta and De Soto Natural Gas districts.

The basic purchase price for all the facilities to be acquired is $11,151,128, subject to closing adjustments.

Standard to Construct 316-Mile Products Line

Plans for a new 316-mile products pipe line from the Sugar Creek, Missouri, refinery of Standard Oil Company (Indiana) to Dubuque, Iowa, have been announced by R. E. Nelson, Jr., general manager of products pipe lines.

The new line, he said, is part of Standard's expansion program to help meet the military and civilian demand for more and improved petroleum products.

At Dubuque the line will join an existing products pipe line from Standard's Whiting, Indiana, refinery to Moorhead, Minnesota.

Construction of the Sugar Creek-Dubuque pipe line is scheduled for the third quarter of 1952, according to Nelson. The new line is expected to be ready for use in delivery of petroleum products early in 1953.

Nelson said approval has been obtained from the Petroleum Administration for Defense to construct the line, and priority ratings have been granted to obtain necessary materials.

The new Sugar Creek-Dubuque line will be of 12-in. pipe. It will traverse northern Missouri and eastern Iowa, and will transport gasoline, kerosine, tractor fuel, furnace oil, heater oil, and diesel fuel.

Cities Service Would Construct Short Line

Cities Service Gas Company, of Oklahoma City, Oklahoma, has applied to the Federal Power Commission for authority to construct about 21 miles of natural gas transmission line in Franklin and Anderson counties, Kansas, and to add a 1000 hp compressor unit at its Welda station in Anderson County.

The 21 miles of 26-in. line would replace two existing parallel 16-in. lines. Estimated cost of the replacement is $984,000, and cost of the additional compressor unit is estimated at $218,500.

The company said the facilities would be utilized to provide required increased line capacity from the Colony and Welda storage fields, thus enabling it to increase its wintertime maximum daily available delivery supply by approximately 60,000,000 cu ft.

Cities Service said that this would assist it in meeting continuing increased requirements for firm service in the Kansas City, Kansas, and Kansas City, Missouri, areas, and provide greater flexibility throughout its entire system.

Cities Service also asked for authority to install an additional 1360 hp at two existing compressor stations in Oklahoma and Missouri and to construct 15.4 miles of 20-in. line to replace a 16-in. line at Kansas.

The facilities, which will increase investment by an estimated $754,800, would be used to provide greater capacity to meet increasing firm demands on the company's southern trunk line and Quapaw-Springfield line.

The proposed new facilities include a 340-hp addition to the company's Welch compressor station in Craig County, Oklahoma; a 1020-hp addition to its Pierce City compressor station in Lawrence County, Missouri, and 15.4 of 20-in. line to replace the 16-in. line in Montgomery and Labette counties, Kansas.

Sunray to Construct New Gathering Lines

Sunray Oil Corporation is preparing to construct approximately 3½ miles of new 4-in. and 3 miles of 5-in. crude oil gathering lines in Stephens County, Oklahoma.

The new Sunray lines will augment its south central Oklahoma system and will serve the Cruce and Doyle production areas to the company's Velma pump station. Sunray purchased a crude oil gathering system in 1950 from Interstate Oil Pipe Line Company to serve this area. Increased drilling activity, plus increased Sunray crude oil purchases, have made additional lines necessary.

Transportation and Storage Facilities Are Sought

United Natural Gas Company and an affiliate, The Sylvania Corporation, both of Oil City, Pennsylvania, have filed applications with the Federal Power Commission for authorization to construct pipe line facilities designed to permit United to handle additional quantities of natural gas.

United's proposed project, estimated to cost about $743,000, includes: (1) the construction of about 10.5 miles of 12-in. pipe line in Venango County, Pennsylvania, to replace about 35,100 ft of 8-in. line; (2) the replacement of 10.1 miles of 3, 4 and 5⅝-in. pipe with the same amount of 6-in. pipe in Warren County, Pennsylvania, and (3) construction of 2000 ft 12-in. line Venango County.

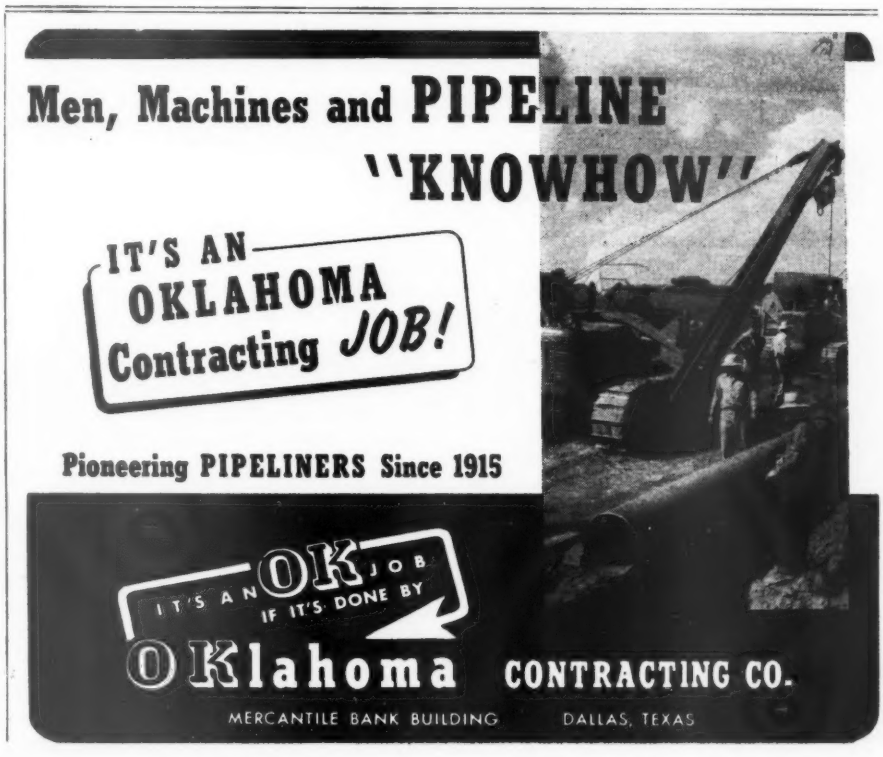
Sylvania is seeking authorization to replace about 12,000 ft of 8-in. and 6500 ft of 4-in. line with 12¾ in. and 6⅝-in. pipe, respectively, in Steuben County, New York, and to install 400 additional horespower at its Tuscarora storage compressor station, in Steuben County. Total estimated cost of these facilities is $390,500. Sylvania said the project would increase its ability to store gas for United in the Tuscarora storage area.

Colorado Interstate Given Temporary Construction Permit

The Federal Power Commission has granted temporary authorization to Colorado Interstate Gas Company, of Colorado Springs, Colorado, for the construction of pipe line facilities that will increase its natural gas transmission system capacity from 360,000,000 cu ft a day to approximately 413,000,000 cu ft.

The company plans to engage in a two-year construction program, estimated to cost $3,453,105, to enable it to meet the demands of customers in the Rocky Mountain market area. The temporary certificate authorizes Colorado Interstate to carry out that part of the construction proposed for 1952. The company is seeking authority to further expand its transmission system capacity to approximately 438,000,000 cu ft a day next year.

The construction authorized under the temporary certificate includes additional compressor units at the company's Panhandle field compressor station, increasing its compressor installation from 4800 hp to 6600 hp; installation of an additional 1320 hp unit at its Kit Carson, Colorado, compressor station, and the construction of about 49 miles of main line loop and lateral lines.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Pioneering PIPELINERS Since 1915
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MERCANTILE BANK BUILDING DALLAS, TEXAS

With the PIPE LINE CONTRACTORS

Trojan Construction Company, 1416½ North Robinson, Oklahoma City, Oklahoma, has contracted to lay a total of approximately 93 miles of 12, 16, and 24-in. pipe for Oklahoma Natural Gas Company. The work will consist of five sections. The first section, 21½ miles of 24-in. between Depew and Kellyville, is now under construction. The field office is at Bristow. Charles T. "Swede" Tillotson is superintendent and Don Wilson is in charge of the field office.

Work also is going forward on 40 miles of 10-in. for Phillips Pipe Line Company between Bay and California, Missouri. The field office is at Linn. "Tex" Maggard is superintendent and Vernon Yeager office manager.

J. L. Cox and Son, Raytown, Missouri, (stringing contractors) on January 1 began stringing 154 miles of 24-in. pipe for Sinclair Pipe Line Company between Cushing, Oklahoma, and Chanute, Kansas. One gang is stringing and two gangs unloading 230 miles of 20-in. on the Platte Pipe Line Company job between Wood River, Illinois, and Kenmoor, Missouri. Also for Platte, 180 miles of 20-in. pipe is being unloaded between Holdrege and Odell, Nebraska.

For Service Pipe Line Company, 17 miles of 20-in. is being strung between Odessa and Pleasant Hill Junction, Missouri. This job is nearly completed. Also for Service, 19 miles of 16-in. is being strung from Outer Belt to Sugar Creek, Missouri. This work is 50 per cent completed.

Near Jefferson City, Missouri, 40 miles of 10-in. for Phillips Pipe Line Company is almost completed.

River Construction Corporation, 6100 Camp Bowie Boulevard, Suite B, Fort Worth 7, Texas, had the following work in progress on January 18:

Spread No. 1. Red Tatom, superintendent; office, Jackson, Mississippi. Laying 30-in. from the Pearl River 26 miles south of Jackson, Mississippi, to a point 25 miles north of Jackson. Approximately 45 per cent completed.

Spread No. 2. Merle Tatom, superintendent; office, Hazelhurst, Mississippi. Laying 30-in. from McComb, Mississippi, to the Pearl River south of Jackson, Mississippi, approximately 45 miles. About 85 per cent completed.

Spread No. 3. Jimmy Reed, superintendent; office, Kosciusko, Mississippi. Laying 30-in. from Kosciusko south to approximately 30 miles north of Jackson, approximately 30 miles, job just started.

Spread No. 4. Roy Earnhart, spreadman; office, Jeanerette, Louisiana. Laying 12-in. from Lafayette, Louisiana, to Jeanerette, Louisiana. Approximately 29 miles; 95 per cent completed.

Spread No. 5. Charlie Simmons, spreadman. Installing river crossings and setting valves on the 30-in. main line and 24-in. line, McComb to Baxterville.

The above spreads are on the east portion of the approximate 1000 miles of additions to the existing facilities of the United Gas Pipe Line system in Texas, Louisiana, and Mississippi.

Spread No. 6. "Banty" Traweek, spreadman. Laying 20-in. from Orange to Port Neches, approximately 20 miles; 95 per cent completed. Will move to Trinity River and lay toward Houston.

Spread No. 7. "Borger Red" McMenamy, spreadman. Laying 20-in. and 26-in. from Port Neches to Fannett. Will continue on to the Trinity River.

Spreads No. 6 and 7 are under the general supervision of Barney Hall with offices at Port Arthur and are on the United Gas Pipe Line 97-mile, 20, 24, and 26-in. line from Orange to Houston.

Jake Minyard is the general superintendent over all the operations for River Construction Corporation with headquarters at Fort Worth, Texas, P. O. Box 9127. Phone: Sunset 6518 office and Sunset 2104 warehouse.

Oklahoma Contracting Company, 6512 Hines Boulevard, Dallas, Texas, is working three spreads on the United Gas Pipe Line Company project in South Texas. The spread under "Panama" Shiflett has completed laying pipe on the sections between the Colorado River and Edna and the Guadalupe River and Edna and is now working on a 17-mile section from the Needville station to the Colorado River. When this is finished work will be north from Needville station. The spread has moved its field headquarters from Victoria to Rosenberg. In all, this crew will lay approximately 100 miles of 30-in. from a point near Wharton to Refugio.

The spread under Raymond Law has been held up by delay in certain right-of-way procurement but is at work again. This section is approximately 86 miles of 30-in. from Pierce Junction to Refugio and about 21 miles remains to be laid. Headquarters are at Victoria.

Laying got under way in January on the 53-mile section of 24-in. between Refugio and Agua Dulce and 15 miles of pipe was in the ground January 22. This spread is in charge of Ed Flannagan and has its headquarters at Sinton.

Bills and Troth Construction Company, 428 Wright Building, Tulsa, Oklahoma, is constructing 122 miles of 8-in. products line for Standard Oil Company (Indiana) between Neodesha, Kansas, and Belton, Missouri. The field office is at Chanute, Kansas. Carl Bills is superintendent and Vivian Grizzell office manager.

Mid-States Construction Company, P. O. Box 417, Mount Vernon, Illinois, is constructing for Phillips Petroleum Company a total of 42.3 miles of pipe line, consisting of the 21.9-mile Leeton station loop between Green Ridge, Missouri, and the Syracuse station, and the 20.4-mile Rosebud station loop between Delmold and Villa Ridge, Missouri. The pipe is 10 in. The job began January 1 and completion is expected about March 1.

The field office is at Sedalia, Missouri. T. H. Edmonds is superintendent; Ed Rensch, office manager; Al Bostic and Narrah McCoy, timekeepers; Bluford Miller, right-of-way and clean-up foreman; Dean Daughhetee, stringing; Roy Lynch, ditch; Ben Edmonds, ditch and bending; J. W. Griffith lowering-in and tie-ins; W. D. Badgett, road crossings, and J. C. Fitzgerald, chief inspector.

Parkhill Truck Company, P. O. Box 1856, Tulsa, Oklahoma, has the following work in progress:

122 miles of 8-in. for Standard Oil Company (Indiana) from Neodesha, Kansas, to Sugar Creek, Missouri. Harold Deatherage, foreman.

94 miles of 20, 24, and 26-in. for United Gas Pipe Line Company (contractor, River Construction Corporation) from Port Neches to Houston, Texas, R. M. Hiser, foreman.

26 miles of 20-in. for Ohio Fuel Gas Company, (contractor, Sheehan Pipe Line Construction Company), from Xenia to South Solon, Ohio. Ira Gould, foreman.

150 miles of 30-in. for Texas Eastern Transmission Corporation from Wheelersburg, Ohio to Powhatan Point, Ohio, and 66 miles from Uniontown, Pennsylvania, to Moundsville, West Virginia, (contractor, Anderson Brothers Corporation). Foremen, Ray Herron and Jimmie Stubblefield.

125 miles of 30-in. for United Gas Pipe Line Company, (contractor, River Construction Corporation), from Louisiana-Mississippi state line to north crossing of the Pearl River near Jackson. Foreman, Charles Sampson.

36 miles of 30-in. for United Gas Pipe Line Company (contractor, River Construction Corporation) from north crossing of Pearl River to Kosciusko, Mississippi. Foreman, O. C. York.

280 miles unloading Shell Pipe Line Company's 14-in. pipe from Wood River, Illinois, to East Chicago, Indiana.

28.6 miles of 20-in. pipe for Service Pipe Line Company's loops in Northern Oklahoma and southern Kansas.

41 miles of 10-in. for Phillips Pipe Line Company, on Harrisonville and Louisburg loops in Missouri and Kansas (contractor, Smith-Donaho Contracting Company). Foreman, John Greer.

KAPCO ROCK SHIELD

FROM MIDWESTERN

Kapco Rock Shield offers positive pipeline protection in rocky areas. It replaces dirt padding thereby ending costly tie-ups of manpower and equipment. Field tests have proven its superior impact resistance as compared with dirt padding methods.

Kapco Rock Shield has been used successfully on river and road crossings . . . for placing between coated pipe and river clamps . . . for protecting coated pipe at railroad crossings. In short, Kapco protects pipe, wrap and enamel wherever and whenever working conditions would tend to cause breaks and tears.

Kapco Rock Shield users have found that in many instances the installed cost of the board including material, freight and labor falls under costs of ditch padding operations. After a limited amount of experience Kapco Rock Shield can be applied in a few seconds. The Shield bends easily around the pipe and can be quickly strapped into place.

Kapco Rock Shield, distributed by the Midwestern Engine and Equipment Company, is a mastic composition board manufactured in sheets 8' long and in ⅛", 3/16", ¼" and ½" thicknesses. In a series of penetration tests dense limestone rocks were dropped five feet to strike directly on the shield. In spite of this rugged abuse, inspection by electronic detector showed no holidays in the coating. More detailed information on Kapco Rock Shield is available through Midwestern. Write today.

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Associated Pipe Line Contractors, Inc., 3272 Westheimer Road, Houston, Texas, is completing 100 miles of 20, 24, 26, and 30-in. pipe line for the United Gas Pipe Line Company from Napoleonville, Louisiana, to the New Orleans area. The field office is at Morgan City. L. H. Gray is superintendent and Ralph Herwig office manager.

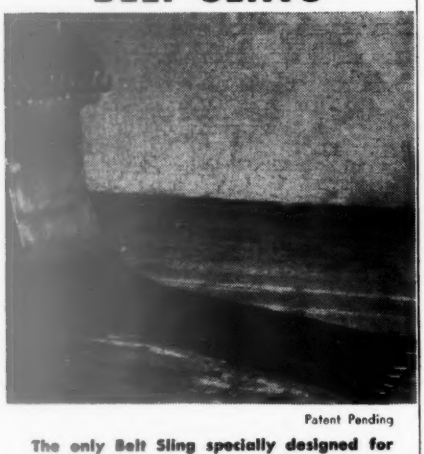
The contractor also is helping out with the Texas Eastern Transmission Corporation job, laying an undetermined amount of 30-in. pipe in Kentucky. The field office is at Scottsville. Cecil Rogers is superintendent and James Luther office manager.

Western Pipe Line Constructors, Inc., Lockhart Building, Austin, Texas, is operating two spreads to do an undetermined amount of 30-in. pipe laying in Kentucky for Texas Eastern Transmission Corporation. One spread is making its headquarters at Danville, where Bennie Williams is superintendent and P. O. Rutledge office manager. The second spread is working out of Tompkinsville. Jack Hodges is the superintendent and A. G. Goyne office manager.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, is engaged in the construction of 20 miles of 20-in. for the Ohio Fuel Gas Company from South Solon to Xenia, Ohio. The field office is at the latter point with Earl "Red" Williams the superintendent and Doyle E. Williams office manager.

NEW WIRE ROPE

BELT SLING



Patent Pending

The only Belt Sling specially designed for Pipe Liners. Surpasses all other Belts in strength and dependability. Easily connected by one man by elimination of heavy bolt. Sizes 10" through 36".

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Vic Knudsen Rigging Co.

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Ray L. Smith and Son, Inc., Hazlett Building, El Dorado, Kansas, has four spreads on the job to take-up, recondition, and re-lay 175 miles of 6-in. products pipe line for Socony-Vacuum Oil Company, Inc., White Eagle Division, between Augusta and Kansas City. The spreads are located as follows:

El Dorado: Dewey Whitworth superintendent.

Tonganoxie, Kansas: "Banjo" Veach superintendent and Karl Smith, office manager.

Burlingame, Kansas: Carl Colvin superintendent and B. L. Beagle office manager.

Topeka, Kansas: Clark Leggitt superintendent and John Salisbury office manager.

Brown-Lite Company, 135 North Sheridan, Tulsa, Oklahoma, is laying 68 miles of 12-in. pipe between El Dorado and Osawatomie, Kansas, for Phillips Pipe Line Company. One spread is working out of Burlington, Kansas, with E. H. Howard in charge as superintendent and H. B. Hoge handling the office. The second spread has its headquarters in El Dorado where "Ace" Holder is superintendent.

Anderson Brothers Corporation, 707 North Drennan Street, Houston, Texas, recently contracted to construct 50 miles of 26-in. line for West Texas Gulf Pipe Line Company. The section is from Hill City to Hillsboro, Texas, and field headquarters are at Glenrose. Rusty Killingsworth is superintendent and Dick Bond office manager. Work began the middle of January.

Comstock Midwestern, Ltd., 206 Laird Drive, Leaside, Ontario, will lay 472 miles of Trans Mountain Oil Pipe Line Company's 693-mile, 24-in. system between Edmonton, Alberta, and Vancouver, British Columbia. This contractor will construct the eastern and western portions of the line. Right-of-way work will begin as soon as weather permits and pipe laying about June 1.

The contractor is laying 235 miles of line for the Sarina Products Pipeline Company, subsidiary of Imperial Oil, Ltd., from Sarnia to Toronto. The pipe is mostly 10 and 12 in. The field office is at Strathroy, Ontario. Denver Franklin is superintendent, E. C. McFadden and B. E. Frans in the office.

Bishop and Lock Construction Company, 1018 Magnolia Building, Dallas, Texas, is making good progress on the 82 miles of pipe being laid for Magnolia Pipe Line Company in Pegasus field of West Texas. Pipe sizes are 3½ in. through 24 in. The field office is at Odessa with Howard Laquey superintendent and Bob Stiles in charge of the office.

It now appears that work may begin sometime in March on the Platte Pipe Line Company job whereas previously the starting date was scheduled for about April 1. The section contracted is 142 miles from Marysville, Kansas, to Holdrege, Nebraska.

C. E. Wilson Construction Company, 1401 Fairfax Trafficway, Kansas City 15, Kansas, is constructing a diesel pumping station for Mid-Valley Pipeline Company near Simpsonville, Kentucky, on its 22-in. crude oil system. Thad W. Wilson is in charge. The job is more than half completed.

For the Iowa-Illinois Gas and Electric Company an undetermined amount of ¾-in. through 6-in. pipe is being laid in the cities of Davenport, Iowa, and Moline, Illinois. Joe Drouillard is superintendent.

Dunn Brothers, 801 Mercantile Securities Building, Dallas, Texas, (stringing contractors) are stringing 22 miles of 26-in. pipe on the Algonquin Gas Transmission Corporation job, which extends from Lambertsville, New Jersey, north. The general contractor is Construction Service Company of Bound Brook, New Jersey.

For Southern Union Gas Company, 30 miles of 8-in. pipe is being strung from Gallup, New Mexico, to a point near Bloomfield.

An undetermined amount of stringing is being done for Tennessee Gas Transmission Company in southeastern Tennessee and Mississippi. Various work also is being done in New Mexico for El Paso Natural Gas Company.

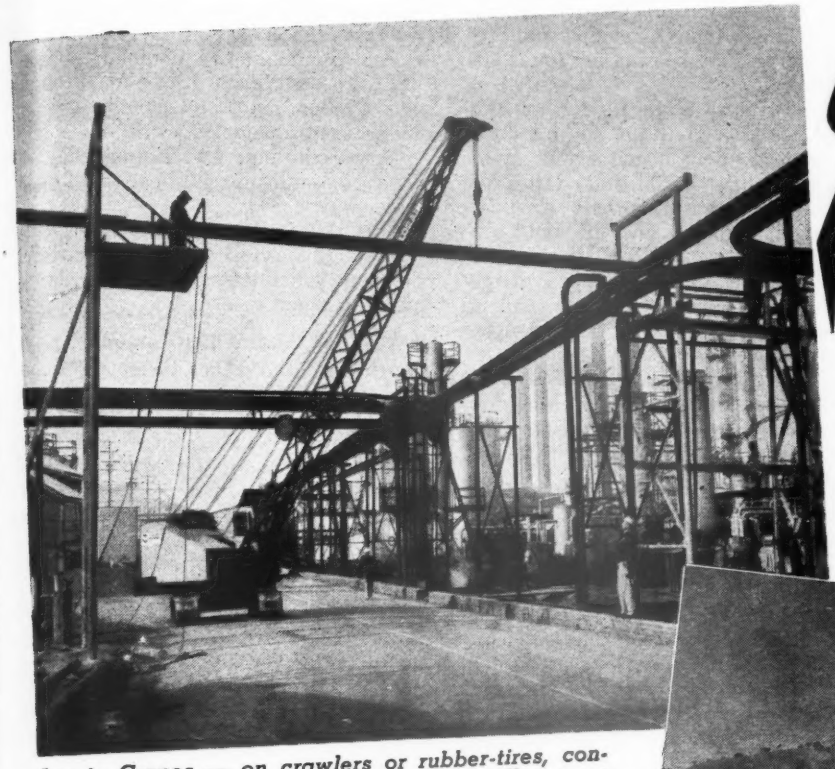
Houston Contracting Company, 2707 Ferndale Place, Houston, Texas, has contracted construction of 308 miles of pipe line for The Texas Pipe Line Company, the work being scheduled to begin in February depending on receipt of pipe. Between Port Arthur, Texas, and Houma, Louisiana, 220 miles of 22-in. will be laid, from Houma to Cocodrie 28 miles of 12¾-in., and in the Terrabonne Bay area a gathering system consisting of 60 miles of 6, 8, and 10-in. pipe.

R. H. Fulton and Company, P. O. Box 1526, Lubbock, Texas, is working on 433 miles of 20-in. pipe line for Platte Pipe Line Company between Casper, Wyoming, and Brule, Nebraska. The field office is at Wheatland, Wyoming, with A. A. Carrigan superintendent and D. G. Wagner office manager. For the Southern Union Gas Company 15 miles of 12-in. and 16 miles of 20-in. are being laid in the vicinity of Farmington, New Mexico. Jerry Nash is superintendent and J. D. Cheek office manager.

Jayhawk Construction Company, Inc., Box 68, Great Bend, Kansas, began January 17 laying 12.5 miles of 4-in. pipe line for the Kansas-Nebraska Natural Gas Company, Pawnee Rock, Kans.

Mannix, Ltd., Calgary, Alberta, will construct approximately 221 miles of the Trans Mountain Oil Pipe Line Company's system, which overall will extend 693 miles from Edmonton, Alberta, to Vancouver, British Columbia. The section will be in the center of the line. Right-of-way clearing will begin as soon as weather permits. Pipe laying is scheduled to begin about June 1. The line will be constructed of 24-in. pipe.

There's a LORAIN to Put Pipe Any Place



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DOWN DEEP

Lorain Cranes — on crawlers or rubber-tires, convertible to dragline or clamshell can handle scores of lifting, loading and excavating jobs. Available in capacities from 6 to 45 tons.

■ Overhead . . . or underground . . . you can solve your pipeline problems with efficient Lorain cranes-shovels. Here are two operations familiar to the petroleum industry. At a large California refinery a Lorain TL25-J crawler crane is used for every kind of job . . . from transporting and erecting miles of pipe to loading and moving large winches and other heavy machinery. This owner gains extra savings on extra jobs with this fully convertible, all-purpose ¾ yd. Lorain.

For cross-country pipelines, there is no hoe to match the Lorain Pipeliner for ditching operations. Whether it's production, transmission, or refining, there is a Lorain model, mounting and front end that will exactly fit your needs. Any of the 125 Thew-Lorain distributor outlets across the country can give you detailed information.

THE THEW SHOVEL CO., LORAIN, OHIO

Lorain Pipeliners — for cross-country ditching — are designed with exclusive features for the pipeline industry — including extra-wide crawlers for straddling ditches. Also draglines, clamshells on crawlers or rubber-tires.

THEW ® LORAIN PIPELINER

Smith-Donaho Contracting Company, 205 Northwest Seventh Street, Fort Worth, Texas, has made slow progress on the Phillips Pipe Line Company job due to mud. The thawing of frozen ground plus rains have made the right-of-way a quagmire. Pipe is being laid now, however. This job consists of 41 miles of 10-in. between Paola, Kansas, and Warrensburg, Missouri, and is a part of Phillips' looping program on its products line. The contractor's field office is at Warrensburg. Herb Smith is superintendent, H. E. Doyle spreadman, and Ernest Bell, office manager.

George Tucker Pipe Line Construction Company, P. O. Box 1987, Odessa, Texas, is laying 51 miles of 8-in. for the Plains Pipe Line Company from the Spraberry field to a pump station near Goldsmith, Texas. The job will take about 45 days to complete due to slow delivery of pipe. D. H. Damron is spread foreman and C. P. Brownell office manager. Paul Tucker is supervising the welders and J. S. Askew is in charge of time and materials.

O. R. Burden Construction Corporation, 6702 East 21st Street, Tulsa, Oklahoma, is laying 154 miles of 24-in. crude oil line for Sinclair Pipe Line Company. The section is between Drumwright, Oklahoma, and Humboldt, Kansas, on the system that eventually will extend to East Chicago, Indiana. One spread has its field office at Yale, Oklahoma, where Floyd Lewis is superintendent and Ben Mapes in charge of the office. The second spread is making its headquarters at Caney, Kansas. Here A. B. Haynes is superintendent and Bill Clyma office manager.

Mike Courtney is in charge of installing crossings of the Cimarron and Arkansas rivers. He has his headquarters at Yale.

On the Platte Pipe Line Company job, M. C. "Tex" Johnson and his crew have moved their headquarters from Troy, Missouri, to Salisbury. Howard Smith is in charge of the field office. R. W. "Dick" Jernigan and his gang are now at Wood River, Illinois. This spread has completed the Mississippi River crossing near Hartford, Illinois, and is now working through the refining area at Wood River.

Overall, Burden is laying 280 miles of the Platte system—from the Missouri River near St. Joseph, Missouri, to Wood River.

Midwestern Constructors, Inc., 105 N. Boulder, Tulsa 3, Oklahoma, had completed (January 15), with exception of clean-up, the Mississippi River crossing near Wittenberg, Missouri, for Texas Illinois Natural Gas Pipeline Company. Three 20-in. lines were installed. The field office for the work was at Grand Tower, Illinois. Howard S. Lipp was coordinator, L. A. "Friday" Davis superintendent in charge of pipe, and Ivan Steele office manager.

Installation of a compressor unit at the Tuscola, Illinois, station of Panhandle Eastern Pipe Line Company was 65 per cent completed. Two units at Edgerton, Indiana, for the same company were 55 per cent completed. K. L. Kreamalmyer is superintendent and H. H. Voss is in charge of the office.

For Aluminum Ore Company, Bauxite, Arkansas, 12,500 ft of 6-in. through 16-in. water, mud, and gas lines were 85 per cent completed.

Process piping: Fabricating shop is completed and pipe fabrication work is under way.

Earl S. Powell is superintendent; Bill Daniels, Eldon Rolfs, and F. C. Snavely, area superintendents, and Morris Garey office manager.

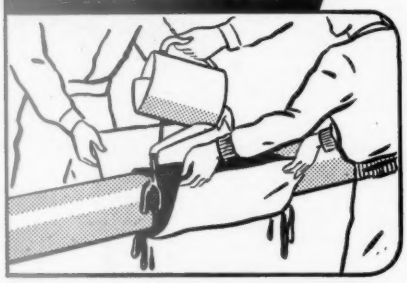
Mahoney Contracting Company, 2300 North Grand Avenue, Lansing, Michigan, is working on approximately 95 miles of 8, 12, 16, 20, 22, and 24-in. pipe line between Laingsburg and Mt. Clemens, Michigan, for Michigan Gas Storage Company. The field office is at Rochester, Michigan. Barney Finnerty is superintendent, Mike Finnerty assistant superintendent, and Al McConnell office manager.

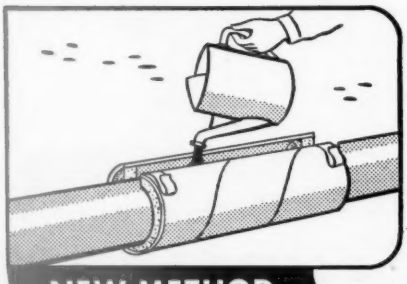
The contractor is finishing up the 30-in. between Ford, Kentucky, and Portsmouth, Ohio, for Texas Eastern Transmission Corporation. The field office is at Vanceburg, Kentucky. Henry Mogg is superintendent, and Joe Cuthbert, office manager.

FIELD JOINTER
PAT. APPLIED FOR

Slip on-Pour full-Lower in

OLD METHOD





NEW METHOD

"Field-Jointer" construction features heavy, rigid, paper mould equipped with felt inserts for each end, preventing waste, plus heavy adhesive tape fasteners. One-quarter inch spacing between pipe and mould gives positive assurance of protection. Slip on—Pour full—Lower in.

The "Field-Jointer" represents a new technique of coating field joints and skid-marks with the same material used on pipe at the coating machine. Slip-on "Field-Jointer" over joint, pour enamel, fasten, and you are ready to lower-in. The canvas sling method is slower, and does not provide assurance of adequate protection for pipe bottoms. Use of "Field-Jointer" provides following features for field use.

★ Eliminates waste of material
★ Eliminates clean-up operations
★ Operates simply requiring no skilled labor
★ Affords positive proof of pipe-bottom protection
★ Prices and additional information, plus arrangements for field demonstrations furnished on request.

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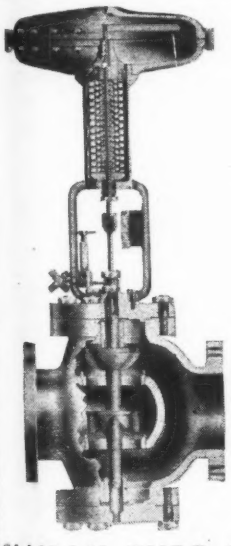
76 BS&B CLIMAX CONTROLS CENTERS



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Diaphragm Control Valve. One of the most widely used controls in the Climax line.

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NEWS

PAD Names 4-Man Group To Watch Fuel Supply

The Petroleum Administration for Defense has set up a four-man body to act if a fuel shortage should threaten the East Coast this winter. Representatives of both major and independent companies, the four men are: Leroy B. Fox, Socony Vacuum, New York City; James C. Richdale, Esso Standard, Melrose, Massachusetts; Gordon C. Currie, White Fuel Company, Somerville, Massachusetts, and James P. Drainie, Waller Petroleum Company, New York City and Baltimore.

Under a new plan, the consultants will work for PAD without pay, receiving only actual expenses. Although they cannot do anything except make recommendations, their advice is expected to weigh heavily with the PAD.

U. S. Mineral Output Jumps 10 Per Cent in 1951

Close to three-fourths of the mineral production of the U. S. (in terms of total value) consists of fuels, according to a Bureau of Mines report issued recently. A large part of this is petroleum, estimated demand for which in 1951 rose to the unprecedented figure of 2,725 million barrels, almost 10 per cent more than in the preceding year. Exports of 156,000,000 bbl were 40 per cent higher than in 1950, partly as a result of the shutting off of the Iranian oil supply at midyear, while domestic demand increased about 8 per cent.

To supply the record demand, the oil industry produced about 2250 million barrels of crude oil, 14 per cent more than in 1950 and more than in any earlier year. In spite of the shortage of materials imposed by the mobilization program, the industry drilled 44,000 wells, more than ever before, and expanded transportation and refining facilities at a rapid rate. Only a small increase (about 5 per cent) occurred in the prices of petroleum and petroleum products compared with the 1950 average.

Looking forward to 1952, it is expected that the rate of increase in all phases will slacken somewhat, with total demand about 5 per cent greater, and crude production up about 3 per cent. Even this moderate increase will require further expansion of the industry's capacity in order to maintain a reasonable margin over current demand.

Production of natural gas continued its rapid rise of recent years, gaining 15 per cent over 1950. Despite restrictions initiated by the Petroleum Administration for Defense, use of natural gas by residential consumers expanded more rapidly than all others, increasing by about 27 per cent.

Equally important with natural gas are the natural gasoline and liquefied petroleum gases (LPG) extracted therefrom. Sustained by the strong demand for petroleum products in general, production of LPG increased 7 per cent in 1951, and of natural gasoline, 22 per cent. Between them, they accounted in 1951 for more than 10 per cent of the total value of fuel production.

Production of nonmetals other than fuels—mostly raw materials for the construction and chemical industries—advanced more than 10 per cent in 1951. There were substantial increases in sulfur demand—from about 5,800,000 to almost 5,900,000 tons. As supplier of about 95 per cent of the world's elemental sulfur, the United States sulfur industry was under pressure throughout the year for maximum production. Sulfur is one of the most basic industrial chemicals. The International Materials Conference, which undertook during the year to allocate sulfur to the various countries of the free world, estimated a world-wide shortage of a million tons.

Texas Oil Allowables Are Raised This Month

After a three-month decline, Texas February oil allowables have jumped to 3,076,141 bbl daily. This is just 52,000 bbl daily below the all time high. The Texas Railroad Commission set the daily rate at 2,930,337 bbl last month, plus 381,043 bbl of liquid hydrocarbons from gas. Most fields will operate 22 days in February. At the meeting of the Texas Railroad Commission, operators suggested reducing production now, and giving extra allowable next summer, but the commission said no such agreement can be made. All buyers of oil wanted more oil in February.

Engineering to Celebrate 100th Year in 1952

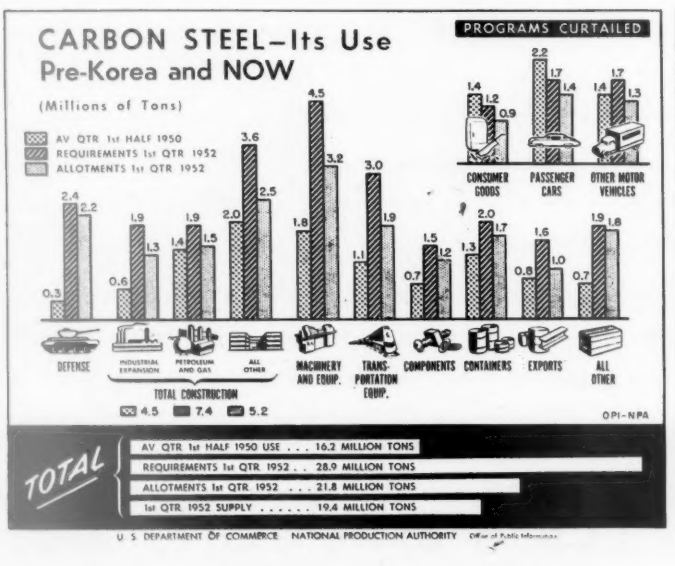
Completion of the 37-man board of directors who will head the Centennial of Engineering celebration to be held in Chicago during this year is announced by Lenox R. Lohr, its president.

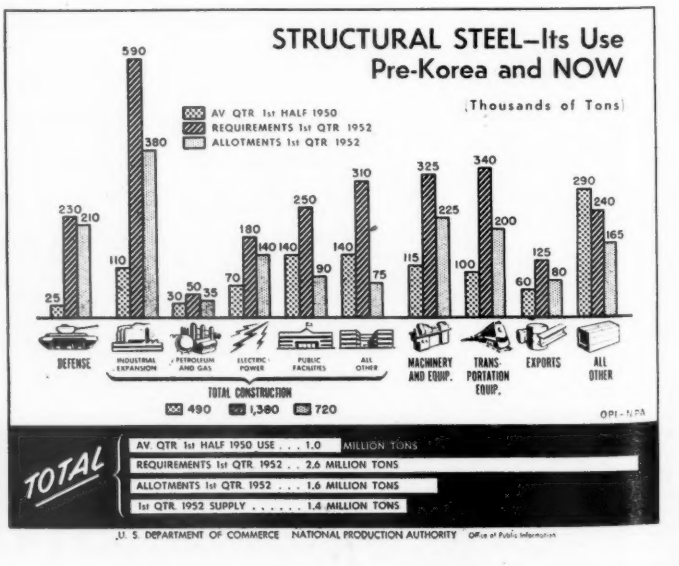
The Centennial, which is being sponsored by 41 national and international groups that include in their membership the great majority of the engineering profession in the United States, will mark the 100th anniversary of the establishment of engineering as a recognized civilian profession in this country. Prior to 1852, when the American Society of Civil Engineers was founded, practically all important engineering work on this side of the Atlantic was conducted by military engineers.

Steel Allotments Up

Petroleum Administration for Defense has announced that steel allotments for pipe for gas and oil pipe lines for the first quarter of 1952 will total 641,599 tons, an increase of 169,369 tons over allotments for pipe lines in the previous quarter. Of the 641,599 tons of pipe allotted, 326,650 tons were allotted for gas lines and 314,949 for oil.

Use of steel by petroleum and gas industries compared to other industries is shown by these charts from U. S. Department of Commerce. Petroleum and gas are third from the left. In the three columns, the first one is for the first quarter in 1950; second, requirements for first quarter, 1952; third, allotments for same period.




STRUCTURAL STEEL—Its Use
Pre-Korea and NOW
(Thousands of Tons)
AV QTR 1st HALF 1950
REQUIREMENTS 1st QTR 1952
ALLOTMENTS 1st QTR 1952
DEFENSE
INDUSTRIAL EXPANSION
PETROLEUM AND GAS
ELECTRIC POWER
PUBLIC FACILITIES
ALL OTHER
TOTAL CONSTRUCTION
490 1,380 720
MACHINERY AND EQUIP.
TRANSPORTATION EQUIP.
EXPORTS
ALL OTHER
OPI-NPA
TOTAL
AV QTR 1st HALF 1950 USE . . . 1.0 MILLION TONS
REQUIREMENTS 1st QTR 1952 . . 2.6 MILLION TONS
ALLOTMENTS 1st QTR 1952 . . . 1.6 MILLION TONS
1st QTR 1952 SUPPLY . . . . . 1.4 MILLION TONS
U. S. DEPARTMENT OF COMMERCE NATIONAL PRODUCTION AUTHORITY

NACE Announces Technical Program

The National Association of Corrosion Engineers has announced the technical program for its eighth annual conference and exhibition, which will be held this year in Galveston, Texas, March 10 through 14. Headquarters will be in the Buccaneer Hotel with meeting rooms and exhibits on the Galveston Pleasure Pier. The technical program is as follows:

Monday—March 10

9:00 a.m. Registration all day.
Committee meetings all day.
Set up exhibits all day.

Tuesday—March 11

9:00 a.m. Committee meetings.
11:00 a.m. General business meeting.
2:30 p.m. Corrosion Principles Symposium:
Motion Picture—"Corrosion in Action."
15 minute introduction by F. L. LaQue of The International Nickel Co.
Round table discussion of motion picture.
6:00 p.m. Fellowship Hour and Barbecue, Texas Style.

Wednesday—March 12

9:00 a.m. Oil and Gas Production Industry Symposium:
"Stress Corrosion Cracking of Steels Under Sulfide Conditions" by C. N. Bowers, W. J. MaGuire and A. E. Weile, Gulf.
"Cracking of High Strength Steels in Hydrogen Sulfide Solutions" by J. P. Fraser and R. S. Treseder, Shell Development.
"Field Experience with Cracking of High Strength Steels in Sour Gas and Oil Wells" by NACE Technical Practices Committee 1-G—Sulfide Stress Corrosion.
"Cathodic Embrittlement on Tubing Steels" by F. A. Prange, Phillips.
9:00 a.m. Chemical Industry Symposium:
"Corrosion by Sulfur and Sulfur Compounds at Elevated Temperatures" by W. Z. Friend and E. N. Skinner, The International Nickel Company, Inc., N. Y.
"Kel-F Application in Corrosive Systems" by L. C. Rubin and W. O. Teeters, M. W. Kellogg Co., Jersey City, N. J.
"Corrosion by Flourine and Flourine Compounds" by Ralph Landau, Scientific Design.
"Effects of Mercury and Aluminum and Non-Ferrous Alloys" by R. H. Brown, Aluminum Co. of America.
"Polarographic Studies of Corrosion of Iron and Ferrous Alloys by Sulfur Dioxide" by A. H. Gropp, University of Florida. Gainesville.
2:00 p.m. Oil and Gas Industry Symposium (Continued):
"Laboratory Apparatus for Studying Oil Well Subsurface Corrosion Rates and Some Results" by W. F. Rogers, P. J. Kalish and J. A. Rowe, Gulf.
"Methods of Corrosion Testing in the Oil and Gas Production Industry" by H. L. Bilhartz and H. E. Greenwell, Atlantic Refining.
"Corrosion Control in Gas Lift Wells" by D. A. Shock and J. D. Sudbury, Continental Oil.
"Sour Oil Well Corrosion" by J. A. Caldwell, Humble Oil and Refining.
2:00 p.m. Refinery Industry Symposium:
"Some Observations of the Potentials of Stainless Steels in Flowing Sea Water" by K. M. Huston. Armco Research Laboratories, Baltimore, Md., and R. B. Teel, International Nickel.
"Economics of Industrial Maintenance Painting" by Robert R. Pierce, Pennsylvania Salt Manufacturing.
"Corrosion Prevention of Distillation Process Equipment with Organic Inhibitors" by George E. Purdy, Tretolite Co.
"Graphitization of Carbon and Low Alloy Steel Plate Used for High Temperature Service" by Joseph G. Althouse, Lukens Steel Company.
"Treatment of Recirculated Cooling Water" by J. K. Rice, Cyrus Wm. Rice and Company.

Thursday—March 13

9:00 a.m. Electrical and Communication Industry Symposium:
"An Improved Electronic Switch" by V. B. Pike, Bell Telephone Laboratories.
"Isolation of Trolley-Bus Negative Return to Prevent Stray Current Corrosion" by Stanley M. Seidman, Ohio Bell Telephone, Harvey E. Nerhood and Richard H. Travers, Ohio Edison, Akron and Louis Harvath, Ohio Bell Telephone.
"A Laboratory Method for Evaluating Steam Condensate Return Line Corrosion Inhibitors" by Harold I. Patzelt, National Aluminate.
"Rectifiers Used for Cathodic Protection Systems" by T. J. Maitland, American Telephone and Telegraph.
9:00 a.m. Protective Coating Industry Symposium:
"Protection of Off-Shore Production Equipment" by H. L. Bilhartz, Atlantic.
"Coating Experiences with Cathodic Protection—Underwater" by Ray Devoluy, C. A. Woolsey Paint Company.
"Values of Surface Preparation and/or Pre-treatment for Use in Conjunction with Various Outstanding Paint Systems in Industrial and Marine Atmosphere" by J. C. Hudson and F. Fancutt, British Iron and Steel Research Association.
"Metallizing Economics in Modern Industry Surface Application Studies" by R. J. McWaters, Metallizing Engineering Co.
2:00 p.m. Oil and Gas Transportation and Storage Industry Symposium:
"Aluminum Alloys for Offshore Pipe Lines" by E. T. Wanderer, Aluminum Company of America.
"A New Development in Magnesium Anode Protection" by Oliver Osborn and R. C. Jorgensen. Dow Chemical.
"Electrical Measurements Applied to Corrosion Investigations" by W. R. Schneider, Pacific Gas and Electric and David Hendrickson, East Bay Municipal Utility.
"Cathodic Protection of Tank Bottoms" by S. P. Ewing, Carter Oil Company.
"The Role of Oxygen in Corrosion and Cathodic Protection" by R. B. Comeaux, Humble.
2:00 p.m. Marine Industry Symposium:
"The Use of Magnesium Anodes in Cathodic Protection" by H. A. Humble, Dow Chemical.
"Gasoline Resistant Tank Coatings" by Walter Cranmer, Philadelphia Naval Shipyard.
"Corrosion Resistant Characteristics of Iron Modified 90/10 Cupro-Nickel Alloy" by W. C. Stewart, Engineering Experiment Station, Annapolis, Md., and F. L. LaQue, International Nickel.
"Studies on the Relationship Between the Profile Depth of Grit Blasted Surfaces and the Coating Thickness" by Max Kronstein, New York University.

Friday—March 14

9:00 a.m. Pipe Line and Underground Corrosion Round Table:
Chairman, Kirk H. Logan, Cast Iron Pipe Research Institute, Washington, D. C., and Co-Chairman, O. C. Mudd, Shell Pipe Line.
9:00 a.m. General Corrosion Round Table:
Chairman, R. B. Hoxeng, U. S. Steel Company and co-chairman, Frank L. Whitney, Monsanto Chemical.

Brown Assures Farmers Crude Supply Adequate

American farmers were assured of an increasing supply of crude petroleum for an expanding use of oil-powered machinery that has virtually retired the horse from the farm, recently. Russell B. Brown, Washington, D. C., general counsel of the Independent Petroleum Association of America, told a special petroleum conference of the National Council of Farmer Cooperatives that "this nation need never be short of horsepower for the generations of the future."

Refuting many past claims and statements that the United States is "running out of oil," Brown cited the petroleum industry's record since World War II as a "basis for confidence" in the future availability of adequate oil supplies. He pointed out that discovered reserves of crude petroleum today stand at an all-time high of 31 billion barrels, as compared to 23½ billion barrels at the end of the war.

Humble Stock Given Rice

A gift to the Rice Institute of 20,000 shares of Humble Oil and Refining Company stock, having a value of $1,570,000, for the establishment of the Harry Carothers Wiess Chair of Geology, has been announced by Dr. William V. Houston, president of the Institute. The gift was made by Mrs. Olga Kieth Wiess, widow of the late president of the Humble Company. Wiess was a member of the Board of Trustees of Rice from November 8, 1944, until his death, August 26, 1948. Dr. Houston said the income from the gift at the 1951 rate of dividend will amount to $50,000 annually.

Tidelands Bill Up

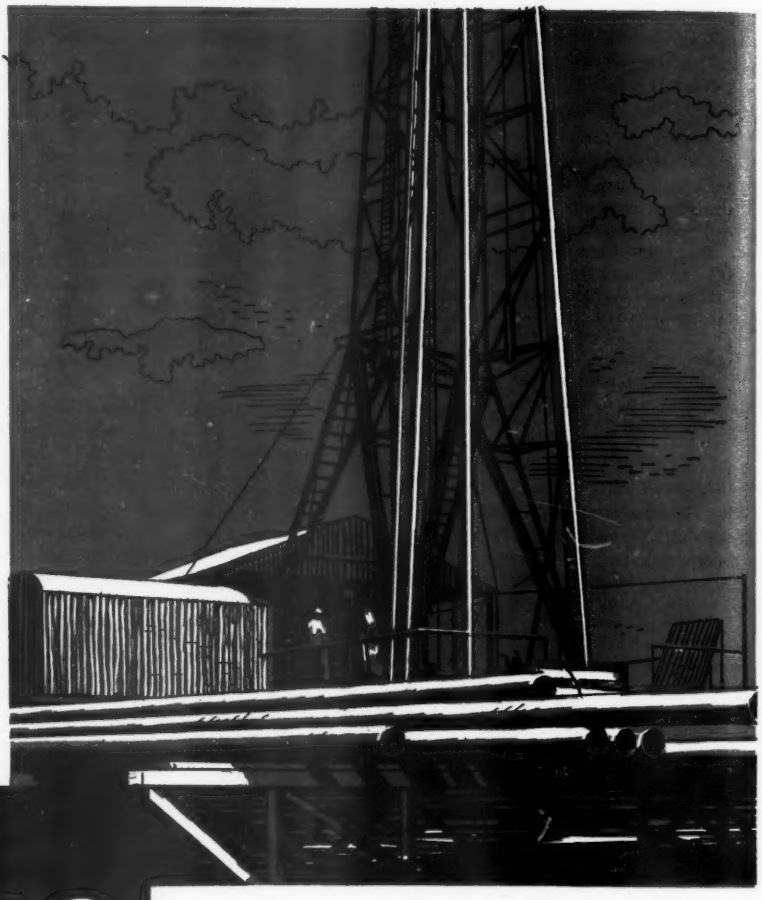
One of the many tidelands bills has been wrested finally from the hands of the Senate Committee and is now before the Senate. State ownership senators, headed by Tom Connally of Texas will attempt to get a measure passed similar to the one passed by the House last year, by changing the bill on the floor.

Wilshire Stock Acquired

The controlling stock in Wilshire Oil Company, Inc., has been acquired by B-L and Associates, Inc., a corporation formed by Blyth & Company, Inc., and Lehman Brothers. The stock purchased consists of all of the stock owned by the heirs of Alfred and Victor Machris. George L. Machris is retaining his stock interest in Wilshire.

The Wilshire Oil Company has been in operation since 1919. A board of directors meeting of Wilshire was held consisting of: Charles R. Blyth, Donald N. McDonnell, William L. Holloway, Howard Pyle, George L. Machris, and Ray C. Shibe. Charles R. Blyth was elected president of Wilshire. Maurice Machris will continue active in the affairs of the company.

FOR THE Extreme Conditions of DEEP-WELL COMPLETION—



SPANG EXTREME LINE CASING

Spang Extreme Line Casing was developed to meet the extreme well conditions encountered in modern deep-drilling operations—severe and variable conditions which require casing with the mechanical and metallurgical strength to withstand high tensile loading and resist extreme liquid and gas pressure.

For detailed information on these eight points of superiority, ask for Bulletin #352, or call at the nearby National Supply Store.

THE NATIONAL SUPPLY COMPANY NSCO — NATIONAL BLUE PRODUCTS

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT

There are eight major reasons why it pays to use precision-manufactured Spang Extreme Line Casing for the really tough jobs of hole protection.

- **High joint strength**
- **Positive fluid seals**
- **Maximum running-in efficiency**
- **Minimum outside joint diameter**
- **Resistance to thread damage**
- **Streamlined exterior contour**
- **Smooth bore without constrictions**
- **Integral joints which eliminate half the threaded connections in standard coupled casing**

SPANG-CHALFANT DIVISION

THE NATIONAL SUPPLY COMPANY

GENERAL SALES OFFICES: PITTSBURGH 30, PA.

DIVISION TUBULAR OFFICES: DENVER, COLORADO • HOUSTON, TEXAS • FORT WORTH, TEXAS • LOS ANGELES, CALIFORNIA • PITTSBURGH, PENNSYLVANIA • TULSA, OKLAHOMA • CALGARY, ALBERTA, CANADA

SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

Oil Women Make Plans For First National Convention

Eight oil women from the South and West met recently to make plans for the first national oil women's convention to be held in Houston's Shamrock Hotel, October 24-25, 1952. Coming from as far west as Los Angeles, the officers and regional directors of the association of the Desk and Derrick Clubs of North America met for the first time in New Orleans, and will be the sponsoring group for the October convention of all Desk and Derrick members. In accompanying photo are, seated: Blanche M. Kelley, first vice president, Union Oil of California, and Katherine Barnes, regional director (V), Schlumberger Well Surveying of Los Angeles; Mrs. Lee Wilson Hoover, A. H. Howard, New Orleans, president; Lucy Dee Owen, second vice president, Oil and Gas Journal, Houston; Margaret Neff, regional director (III), Dixie Geological Service, Jackson. Standing, Mrs. Rosalie Jordan, public relations chairman, Oil Industry Information Committee, Dallas; Enid Bahle, secretary, Shell Oil Company, and Virginia Murray, treasurer, Schlumberger Well Surveying, New Orleans.

National officers of oil women's Desk and Derrick Club.

Sun Collects 16,000,000 Lb Of Steel Scrap Since June

Sixteen million pounds of steel scrap and 140,000 lb of copper and brass have been collected by Sun Oil Company in a pilot operation designed to provide guides for the oil industry in similar undertakings. Most of this scrap, according to Paul D. Barton, Sun's chief engineer, resulted from the dismantling of obsolete refinery units, buildings, storage facilities, and equipment.

Figures released by Barton refer only to scrap collected since June in connection with a special intensified program in which Sun is serving as a "guinea pig" for the entire petroleum industry at the request of the American Iron and Steel Institute.

Small Operations Advised On Tubular Supply

The Petroleum Administration for Defense has announced that drilling operators who normally drill from 1 to 11 wells in a year may get oil-country tubular goods from their regular supply stores. The announcement was made to clarify any mistaken beliefs that operators would be required to make purchases at PAD field warehouses.

An operator fitting into this category must: (1) File before the announced deadline with the PAD, presenting his schedule requirement. (2) If his application for priorities assistance is granted, he will receive a letter from PAD setting forth the total tonnage of oil-country tubular goods he will be permitted to draw from stocks during the quarter. (3) When operator is preparing to begin actual drilling, he must file with PAD, at least 15 days before the material is needed, four copies of form PAD-15 for each well he has planned.

Sulfur Shortage to Grow Worse in '52; Williams

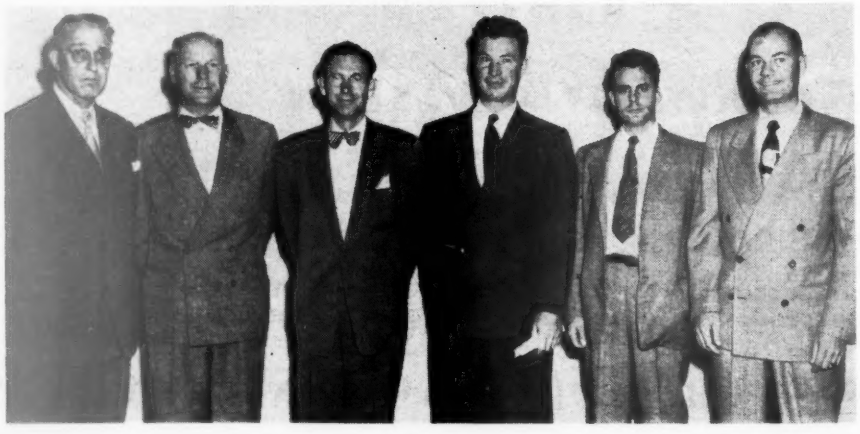
The world shortage of sulfur, which became pronounced as 1951 wore on, will become worse in 1952 as the rearmament program of the United States and its allies gains momentum, Langbourne M. Williams, Jr., president of Freeport Sulphur Company, predicted.

Despite record production by the American brimstone industry, the discovery of a large new deposit and projects to develop three others, "any significant increase in the overall supply of sulfur is at least a year away," Williams said in an appraisal for the new year.

U. S. production of sulphur in all forms in 1951 totaled approximately 6,200,000 long tons. Of this amount, it is estimated that 5,325,000 tons was elemental sulfur or brimstone from Gulf Coast salt dome deposits, 200,000 tons was brimstone recovered from refinery and sour natural gases, 400,000 tons was sulfur in pyrites, and the remainder was sulfur obtained in other forms from smelter gases and other sources. Production in 1950 approximated 6,000,000 tons.

While production for 1951 was sufficient to fill domestic needs, it was not enough to meet both domestic and export demand.

Los Angeles Basin Chapter of API. Officers and retiring officers after the recent elections during the last scheduled meeting for 1951 are: Charles Gandaubert, General Petroleum, retiring chairman; William "Andy" Anderson, Oil Tool, retiring secretary-treasurer; Stafford Park, Fullerton Oil, chairman, 1952; Tal Ledbetter, Union Oil, vice-chairman; Art Curran, Schlumberger Well Surveying, secretary-treasurer elect; Herman Schaller, McCullough Tool, assistant secretary treasurer.



Conference on Clays Set

A national Conference on Clays and Clay Technology will be held on the Berkeley campus of the University of California July 21 through 25, 1952. This conference will provide an opportunity for those engaged in fundamental studies of clays and clay technology to meet and share scientific, technologic, and engineering experience.

Outstanding authorities in the field of clays and clay technology will speak on origin, occurrence, mineralogy and fabric of clays; structure, electro-properties, ion exchange, adsorptive and swelling properties of clay; methods of identification and their interpretation.

Gas Companies Estimate Demands Through 1955

The Petroleum Administration for Defense has sent questionnaires to about 200 gas companies in an attempt to get a firm forecast of the steel requirements of the gas industry through 1955. The 200 companies, which accounted for 91 per cent of the gas used in the U. S. in 1950, are asked for estimates of demand for gas if mobilization needs continue.

Thus far, the Administration reported, estimates for the oil and gas industries under the Controlled Materials Plan have been limited to 1951 and 52. PAD added that it was essential that a thoroughly documented study of gas supply and requirements and of related steel requirements, now be undertaken for natural, manufactured, and mixed gas by years through 1955.

Gas Companies Protest Law

Seven big gas companies are protesting a tax law passed in Texas last September 1, aimed at keeping that state's finances on a sound basis. The protest has been brought up despite Governor Shivers' warning that if the law is voided and the state forced into a deficit, a special session of the Legislature might be called that would pass a tougher tax on the gas industry.

Gas companies gave notice with their first tax payment in October that they would contest the new levy. The tax is 9/20 of 1 cent per 1000 ft of gas gathered. Seventy-six companies paid taxes on October production under protest while 104 did not protest. Only the companies that did protest will be able to recover the money, if the tax is voided. Pending a decision of the suits the money is tied up and the state cannot use it.

Seven companies are Texas Gas Transmission, Panhandle Eastern Pipe Line, Cities Service Gas, Natural Gas Pipe Line of America, Texas Illinois Natural Gas Pipe Line, Texas Eastern Transmission Corporation, and Michigan-Wisconsin Pipe Line. All are engaged in interstate commerce in the sale of Texas gas.

Holman Sees 7 Per Cent Increase in Oil Demand

Eugene Holman, president of Standard Oil (New Jersey), has predicted that world and domestic demands for crude oil will increase 6 or 7 per cent in 1952. Oil requirements jumped 9 per cent in 1951. He also forecast that the oil industry will be able to meet these needs and maintain its proved reserves at the same time. He emphasizes that improved techniques will play a major part in meeting ever-increasing demands for oil.

San Juanito Oil Formed

Robert J. Bradley has announced formation of the San Juanito Oil Company, of which he will head as president. The new company is a result of the acquisition of San Juan Oil Company by General American Oil Company under a stock agreement exchange. Bradley was president of San Juan. J. A. Crichton is vice president of San Juanito, and Otis T. Griffin, treasurer.

How Teachers Learn About Oil Industry in Houston

Weldon B. Hill*

"While I cannot say that I am prepared to drill a successful oil well, I do have a better knowledge and appreciation of the oil industry than I have had from casual observation."

This statement came from a teacher in the Houston public school system after she had completed a guided-tour of an oil field during Houston, Texas', second annual Business-Education Day recently.

B-E Day is sponsored by the Houston Chamber of Commerce and all business in highly-industrialized Houston cooperate.

This year 350 Houston firms were hosts to 4,100 Houston school teachers, both from public and parochial schools, and from Rice Institute and the University of Houston.

Business was given an opportunity to show its wares to perhaps the most significant thought-moulding group of any community. B-E Day is an excellent public relations medium.

Business and education leaders are brought closer together in an atmosphere conducive to understanding each other's problems.

In Houston, B-E Day is a well organized activity.

Each teacher is scheduled for one specific host firm and no teacher is the guest of any firm twice in succession. Each participating firm is supplied a list of the teachers who will be its guest for the day and the firm is expected to make an attendance report.

The size of each teacher-party depends upon the number of guests invited by the individual firm. This year the tours ranged in size from 2 to the 250 entertained by the Southern Pacific Lines.

The activities of the day are outlined and prepared well in advance by the business firms. Banks, insurance companies, some oil companies, and other businesses conducted the teachers on a tour of their facilities in Houston.

Manufacturing companies gave the teachers an inside view of their plants.

The teachers also saw actual drilling operations, on land and in the waters of Galveston and Trinity Bays. Refineries in the Houston area were hosts to hundreds of teachers who had heretofore viewed refineries from the roadside.

Accompanying the teachers on all of the tours were top-flight executives and experienced employees who explained the various phases of their business and readily answered questions.

The teachers also are guests of the business firms at a luncheon on B-E Day. These luncheons are attended by the top executives of the host companies who remain for the discussion period during the afternoon.

Straightforward answers are given to the many questions regarding administration, profit and loss, and production.

Also the executives are prepared to give the teachers an insight on what business and industry contribute toward the community. This includes taxes, charity donations, pensions, and employment for the physically handicapped.

The week after B-E Day, the business firms receive many letters from the teachers expressing their reaction to the day's activities.

"My trip to the oil fields gave me a greater appreciation of the vast amount of time, energy, knowledge. and expense required for the operation of a modern oil company," was in a letter one oil company received.

Another letter said:

"I was greatly impressed with the efficiency of operation and your safety record."

B-E Day in Houston also provides businessmen an opportunity to "go back to school."

Last spring, businessmen were guests of the teachers in the classrooms. Another tour of the schools is planned next April.

J. H. Russell, vice president of Gulf Oil Corporation in charge of pipe line operations and oil purchasing in the United States and Canada, has this to say about B-E Day:

"We of Gulf Oil have cooperated with the Houston citizens committee on B-E Day for two years. We have had the teachers as our guests on two field trips. Representatives of all departments of the company have visited in the schools.

"I think B-E Day is one of the finest, most constructive enterprises the Houston Chamber of Commerce has ever sponsored."

And what do the school children think about B-E Day?

It's swell. They get a holiday.

*Oil Editor, Houston, Texas, Post.

PERSONALS

Robert A. Stromberg has been named second district representative of the New York-New Jersey district for the Oil Industry Information Committee. Stromberg, who was formerly on the staff of Columbia University, replaced **John Goodman,** who was promoted to district representative in the Boston office. Other appointments include:

David H. McIlvaine, Middle Atlantic district, with headquarters in Philadelphia. McIlvanie, formerly assistant publicity director for the University of Pennsylvania, filled a vacancy created by a resignation.

John H. Marsh, Kentucky-Ohio-Tennessee district, Cincinnati, succeeding **J. W. Lenon,** who was named senior district representative in the same district. Marsh was formerly with the editorial staff of Standard Oil Company (Ohio).

Jacques Ellison, Jr., Kansas-Oklahoma district, Tulsa, formerly publicity director for the University of Oklahoma.

James O. Kemm, Iowa-Missouri-Nebraska district, Kansas City, formerly Springfield, Missouri, newspaperman.

Andrew Neilson

Andrew Neilson has been named vice president and director of the Caltex group of companies. Neilson, who will continue as president of Overseas Tankship Corporation, an affiliate of Caltex, has been directly connected with shipping activities for the past 28 years. Most of this time has been spent with affiliates of Overseas Tankship, particularly as general manager of Pacific Tankers, Inc., San Francisco, until he joined Overseas Tankship Corporation as vice president and general manager in June, 1946. In December, 1947, he was elected president.

The fleet of tankers operated by Overseas Tankship Corporation provides transportation of petroleum products for the Caltex Group from Bahrein and the Arabian fields to points as widely separated as Europe and Australasia.

John J. V. Forbes has been appointed by President Truman as director of the U. S. Bureau of Mines, Department of Interior, to succeed Dr. James Boyd. Forbes has been chief of health and safety division of the Bureau since 1948, but joined the Bureau in 1915.

T. C. Barger was named general manager for concession affairs, of Arabian American Oil Company organization in Saudi Arabia recently. Barger, after a geological background, joined Aramco in 1937 and has specialized in government relations work since 1941. **W. R. Cooper** was appointed general manager of the construction, maintenance, and transportation department. Cooper joined The Texas Company in 1928 and transferred to Aramco in 1944 as superintendent of engineering.

E. C. Austin was appointed general manager of materials, supply and community service. He joined Aramco in 1939 and has served in various capacities since that time. **T. V. Stapleton** was appointed general manager of field management. Stapleton joined The Texas Company in 1923 and worked continuously for them until 1944 when he transferred to Aramco as refinery manager.

R. A. Eeds was named general manager of the field operations department. Eeds has been with various subsidiaries of Standard Oil of New Jersey since 1933 and joined Aramco in 1950 as assistant general manager in charge of oil operations.

W. A. Weber was appointed general manager of industrial relations. Prior to joining Aramco he spent 19 years in personnel work with Standard Oil of California. Also announced was the appointment of **D. N. Ezell** as manager of the manufacturing and supply department and **S. C. Harper** as assistant to the general manager of oil operations. Ezell came to Aramco in 1950 after having been with Magnolia Oil Company since 1938. Harper has been with Aramco since 1944 after having served since 1927 with The Texas Company.

R. S. Hatch was named as "Arabian American's" general manager for materials, supply and traffic. Hatch, after an association of twenty years with The Texas Company, joined Aramco in 1947 as manager of the manufacturing and processing department. **Dale Nix** was appointed general manager of oil operations. Nix has a career of 25 years in the oil industry and joined Aramco in 1940 as manager of the producing pipe lines and transport department.

George Kraigher, whose background includes both combat and commercial flying in many parts of the world, was named general manager of the aviation department. He had served as manager of the department since 1948.

D. M. Brown was made manager of the producing pipe lines and transport department and **Dr. Theodore E. Allen** is associate medical director.

Brown came to Aramco in 1936 as an engineer after working with Standard of California's Producing Department since 1930.

Dr. Allen specialized in industrial medicine since completing his studies at Williams, Yale and Harvard, and joined Aramco in 1949 as assistant to the medical director.

Edwin W. Esmay, of the Standard Oil Company (New Jersey), has been appointed acting executive director of the Oil Industry Information Committee, to serve during the leave of absence of **H. B. Miller,** who has been elected president of the National Committee for a Free Europe.

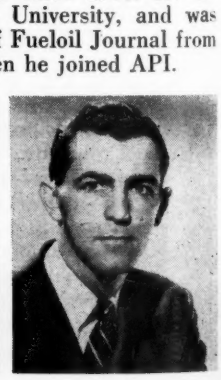
Esmay also will serve as acting director of the American Petroleum Institute's Department of Information, according to President Frank M. Porter. The dual appointment is effective March 1, at which time Miller will take over his new duties as head of the private citizens' organization whose objective is to combat world communism.

Esmay currently is industry liaison representative in the public relations department of Standard Jersey, a position he has filled since 1946. He attended Princeton University, and was associate editor of Fueloil Journal from 1933 to 1937, when he joined API.

G. G. Biggar

R. G. Pearson

H. F. Mulvaney



F. H. Roberts

G. Gordon Biggar, Shell Oil Company's assistant manager in charge of special projects, has been promoted to manager of public relations, New York.

Robert G. Pearson, assistant manager in charge of publicity, has been named manager of the publicity and information division of public relations.

Hugh F. Mulvaney, who has been responsible for Shell's public relations activities in the Southwestern states with headquarters in Houston, Texas, has been transferred to New York as manager of the special projects division of public relations.

Frederick H. Roberts, who has handled public relations art and production, will assume added responsibilities as art director and head of the production and distribution section.

Biggar, a native of Dorchester, Massachusetts, joined Shell in 1926 and held various positions before joining the public relations department in 1942.

Robert L. Minckler, president of the General Petroleum Corporation, was elected to his second term as president of the Western Oil and Gas Association. The Association, established in 1906, has a membership representing approximately 90 per cent of the production, manufacturing, or wholesale distribution of petroleum produced on the Pacific Coast.

L. L. Aubert, president of the Bankline Oil Company, was elected first vice president by the board and **Charles S. Jones,** president of Richfield Oil Corporation, was elected second vice president. **L. K. Whittier,** vice president of the Belridge Oil Company, was re-elected treasurer and John M. Peirce was re-elected vice president and general manager.

Thirty-one incumbent members of the Board were re-elected and **Lowell Stanley,** chairman of the board of directors of the Jergins Oil Company, Long Beach, was elected to replace the late C. M. Cotton.

W. C. Wenzel, executive manager of the Pennsylvania Grade Crude Oil Association, returned recently from a several weeks' European trip on which he visited association members and Pennsylvania oil distributors in nine countries.

Principal problems facing the Pennsylvania Grade oil industry in the European market, he believes, are a continued shortage of dollars and an expansion of lubricating oil manufacturing facilities in the foreign countries visited.

R. M. Jones has been made department head accountant of the accounts payable department, Magnolia Petroleum Department. He replaces **J. L. Sinclair** who retired from Magnolia Petroleum Company after 34 years' service. **H. M. Dean** has been appointed assistant cashier of Magnolia Petroleum Company effective January 1, 1952.

H. S. M. Burns, president of Shell Oil Company, New York, has been appointed chairman of the public relations committee of the board of directors of the American Petroleum Institute by Chairman L. S. Wescoat. He succeeds John M. Lovejoy, president of the Seaboard Oil Company of Delaware, who had served as chairman since 1947. The public relations committee is the board group to which the Oil Industry Information Committee reports.

Lloyd F. Thanhouser, vice president and general counsel of Continental Oil Company of Houston, Texas, and **Rayburn L. Foster,** vice president and general counsel of Phillips Petroleum Company have been named to the American Petroleum Industries Committee for 1952.

Thanhouser was named to succeed **James J. Cosgrove,** former general counsel of Continental who has been chairman of the board of Continental since 1946. Cosgrove was one of the original members of the APIC, serving since 1933 when the committee was first established to study tax and regulatory problems affecting the industry and its customers. Thanhouser is a graduate of Yale University.

Foster's appointment enlarges the APIC from 10 to 11 members. He is a graduate of the University of Oklahoma, began private practice in 1916 and became attorney for the Independent Oil and Gas Company in 1928. That organization was merged with Phillips Petroleum Company in 1930, and Foster became general counsel in 1951.

Dr. Jose Martorano Battisti has joined Shell Caribbean Petroleum Company in Caracas as an assistant manager and member of the executive committee. Dr. Martorano will spend several months abroad studying the operations of companies associated within the Royal Dutch Shell Group previous to taking up his appointment in Caracas.

William M. Amos, of Millburn, New Jersey, Gulf Oil Corporation, will continue in office as chairman of the New Jersey Oil Industry Information Committee for 1952.

Other members of the state committee, which is the public relations organization of the American Petroleum Institute follow: State senior vice chairman, Reynolds C. Buckley, Hartol Petroleum Corporation; state treasurer, Anthony Vroon, Shotmeyer Brothers Oil Company; vice chairman in charge of press and radio publicity, Jack F. Gow, public relations representative of the Tide Water Associated Oil Company, and educational vice chairman, Charles T. Deacon, Wyckoff, of Gulf Oil Corporation.

Speakers' vice chairmen named are: For northern New Jersey, **Edward H. Kauss,** of Sun Oil Company; for central New Jersey, **S. J. McPherson,** of Shell Oil Company; and for southern New Jersey, **C. Frank Fretz,** of Socony-Vacuum Oil Company.

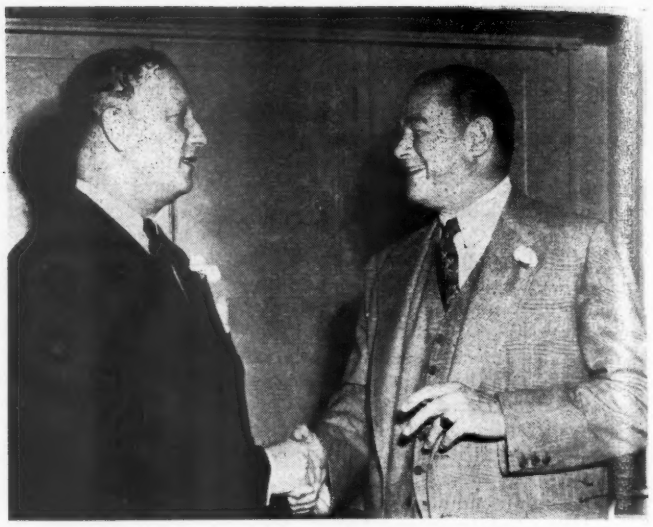
Regional chairmen for the state are: **P. K. Allen,** Esso Standard Oil Company; **Bert Boekemann,** Esso Standard Oil Company; **Ralph L. Davis,** The California Oil Company; **William J. Geiger,** American Oil Company; **Robert W. Weeks,** Esso Standard Oil Company; **John K. McKee,** Trenton, Sun Oil Company; Frank P. Weaver, Margate, of the American Oil Company and William F. Turner, Hackensack, of Esso Standard Oil Company.

Chairmen of refinery districts are: **George W. Crowe,** Esso Standard Oil Company; **Randy B. Johnson,** The Texas Company and Frederick R. Bender, Westfield, of Esso Standard Oil Company.

Lee Carter recently joined Quintana Petroleum Company in Victoria, Texas, as an engineer. A University of Texas graduate, Carter was formerly an engineer for the U. S. Internal Revenue Department.

Dallas D&D Girls Tour East Texas. Members of the Dallas, Texas chapter of the Desk and Derrick Club visited a pumping station, gasoline plant, and a salt water disposal plant on a recent trip through the East Texas field. Host for the trip was Magnolia Petroleum Company. Third from right is Grace Smith, The Texas Company, president, and fourth is Genevieve Galvin, Magnolia, chairman of committee on field trips, and fifth is Martha Binford, Seaboard Oil, president-elect for 1952.

▸ **H. S. M. Burns**, president of Shell Oil Company, New York, has been appointed chairman of the public relations committee of the board of directors of the American Petroleum Institute by President Frank M. Porter. Burns, (left), is being congratulated by John M. Lovejoy, president of the Seaboard Oil Company of Delaware, New York, who retired as chairman of the committee recently after serving in that capacity since the beginning of the Oil Industry Information Committee in 1947. The OIIC is under the jurisdiction of the public relations committee.



H. S. M. Burns, left, president of Shell Oil Company, is being congratulated by API president, Frank M. Porter, upon new appointment as chairman of API public relations.

▸ **Charles E. Simons**, Dallas, executive vice president of the Texas Mid-Continent Oil and Gas Association, has been appointed a member of the American Petroleum Institute's committee on highways, Frank M. Porter, API president, announced. Simons was among 28 prominent petroleum industry officials from over the nation selected to serve on the 1952 Committee.

▸ **Fred B. Behrens** has been named vice president of Wilshire Oil Company, Inc. In addition to retaining his former responsibilities as manager of manufacturing, Behrens is now in charge of engineering, pipe line, and storage operations, and crude oil purchases and exchanges.

Behrens received his degree from the University of Wisconsin in 1928 and

Fred B. Behrens

joined the Universal Oil Products Company that same year in its control laboratory. He was next assigned to experimental laboratory work and later on to pilot plant cracking and non-selective polymerization. This lead to field services for UOP specializing on poly treating and cracking plants.

In 1936 he joined the refinery staff of Wilshire Oil Company as treating superintendent. In 1941 he was promoted to assistant refinery superintendent and in 1945, manager of manufacturing.

▸ **George Link**, foreman of Standard Oil (Indiana's) Woodriver, Illinois refinery, was given top national honors for best male crocheter in the Nationwide Crochet Contest recently. His prize winning entry in the contest was a table cloth crocheted in large square motifs of shadow filet, which took six months to crochet. Link began crocheting at the age of 14 when an attack of rheumatic fever limited his activities.

▸ **Marshall Sittig**, technical writer, and **Patricia Lynn Brown**, literature researcher, have joined the information division of the research laboratories at Detroit, Ethyl Corporation has announced. Sittig, who was formerly with the engineering division of Chrysler Corporation in Detroit, is a native of Oak Park, Illinois, and a graduate of Purdue with a B.S. degree in chemical engineering. Miss Brown was formerly a research associate at Albany Medical College. She is a graduate of Southwestern Louisiana Institute with a B.S. degree in chemical engineering and of the University of Texas with an M. A. degree in Chemistry.

▸ **Harold R. Berg**, Tulsa, regional manager for the Ethyl Corporation, will head the Kansas-Oklahoma district Oil Industry Information Committee during 1952 and 1953. He was elevated from a directorship to succeed **Harry Trower**, Tulsa, former vice president of the Phillips Petroleum Company, who has served as district chairman since 1949.

J. B. Smith, Wichita, vice president of The Vickers Petroleum Company, will continue as vice chairman of the two-state organization. Berg and Smith were selected at a meeting of the oil group's Steering Committee.

The new OIIC head, upon graduation from the University of New Hampshire, went with the Pan American Petroleum and Transport Company. In 1928 he joined the Ethyl Corporation.

Elected to serve with Berg and Smith, as new members-at-large of the Steering Committee were **Earl Berry**, Oklahoma City, Kerr-McGee Oil Industries, Inc.; **S. B. Caldwell**, Tulsa, Mid-Continent Petroleum Corporation; **John I. Cooke**, Oklahoma City, Sohio Oil Company; **E. K. Ketchum**, Oklahoma City, Anderson - Prichard Oil Corporation; **Jim Lookabaugh**, Oklahoma City, president, Oklahoma Oil Marketers Association; **T. B. Murphy**, Tulsa, Deep Rock Oil Corporation; **Millard K. Neptune**, Independence, Platte Pipe Line Company; **R. J. Tibbets**, Independence, Sinclair Pipe Line Company; and **Lloyd Unsell**, Tulsa, Independent Petroleum Association of America.

▸ **W. C. Wenzel**, executive manager of the Pennsylvania Grade Crude Oil Association, returned recently from a several weeks' European trip on which he visited Association members and Pennsylvania oil distributors in nine countries. The executive said he met throughout his trip an enthusiastic interest in the Association's program of promotion and advertising in behalf of the products of Pennsylvania Grade crude oil and enforcement of quality standards.

Principal problems facing the Pennsylvania Grade oil industry in the European market, he believes, are a continued shortage of dollars and an expansion of lubricating oil manufacturing facilities in the foreign countries visited.

▸ **J. H. Sidwell**, formerly chief engineer for Hiawatha Oil and Gas Company, has joined Imperial Production Corporation with headquarters in San Antonio, Texas.

DEATHS

▸ **John M. McMillin**, vice president and director of Cities Service Company, died at his New York home the morning of December 27. He was a graduate of the Massachusetts Institute of Technology, and was first employed by Cities Service in 1908 as a junior engineer in the Cities Service training school. Upon completion of his training, he was transferred to New York. For the 26-year period ending in 1946, he directed the financial affairs of Cities Service. At the time of his death, he was serving in an advisory capacity on these and other executive matters.

▸ **John McCowan Peat**, former Shell Oil Company purchasing and stores manager in Los Angeles, died at Carmel recently following a short illness. Peat was born in Leith, Scotland, and began his career with Shell in January, 1909, as a storekeeper at Oilfields, near Coalinga. Following a series of promotions that took him to Long Beach, Los Angeles, and San Francisco, Peat was appointed manager, purchasing and stores in Los Angeles, on February 1, 1932.

He served in that position until he retired on January 1, 1945.

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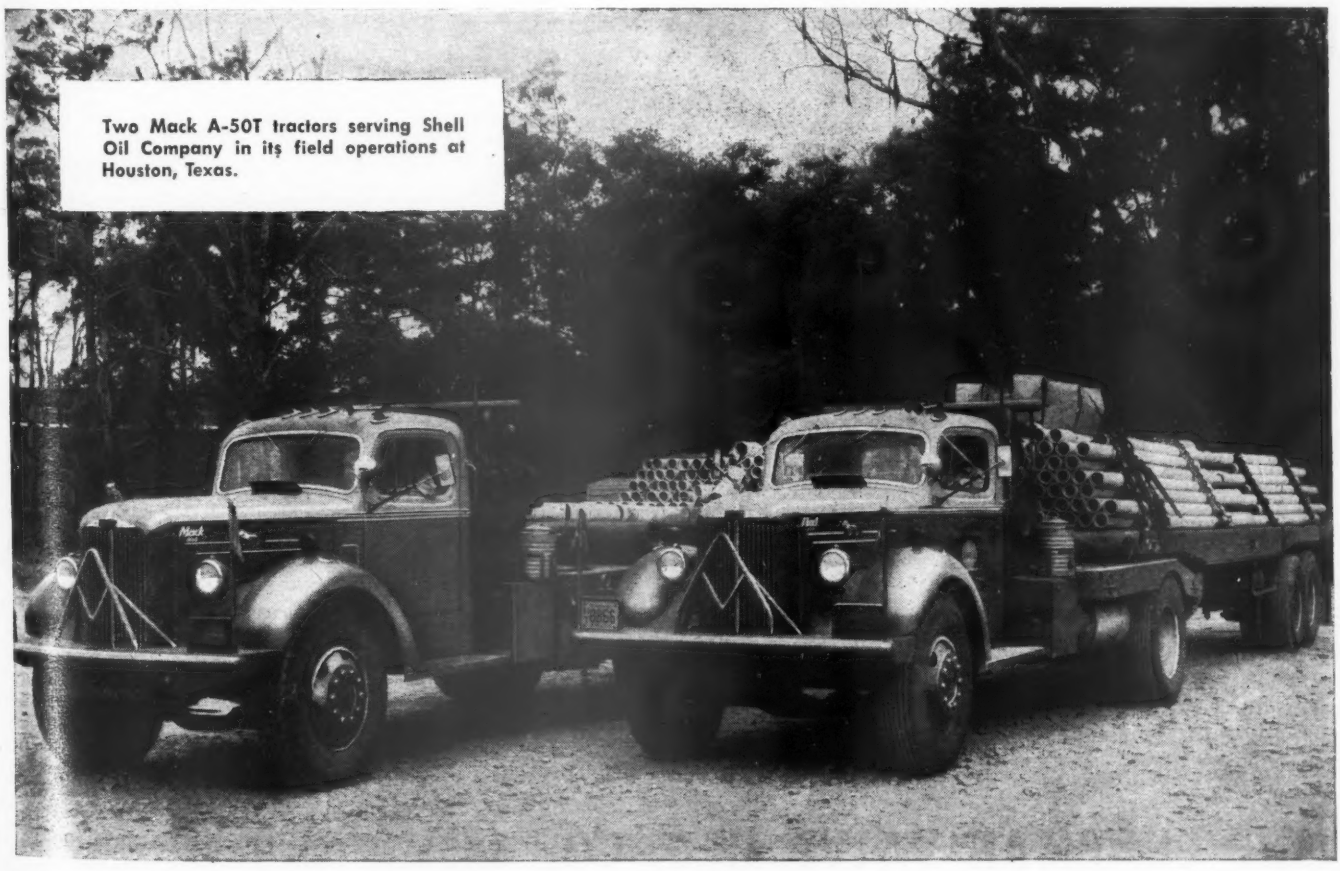

Two Mack A-50T tractors serving Shell Oil Company in its field operations at Houston, Texas.

To obtain more information on products advertised see page E-41

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Extra Protection Against Even Unusual Stress is provided by extra-strong stem-and-wedge-gate connection.

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Longer-Lived Body and Yoke are of forged steel. And bolted follower has no threads on yoke to corrode.

No Seizing or Galling of Gate Faces because List 960's gates (when furnished with certain types of trim) are hardened by *Malcomizing* (patented Chapman process) to a minimum of 800 Brinnell.

An exceptionally wide range of services is covered by this small forged steel gate valve . . . giving you the same consistent top level performance on many different jobs.

Chapman List 960 Forged Steel Gate Valves are manufactured in sizes from ½" to 2" inclusive, and in these 2 types: (1) Rising stem with yoke (shown), and (2) Rising stem with inside screw. Bonnet joints are either gasketed or metal-to-metal. Pressure range: 2000 lb. at 100°F. — 380 lb. at 1000°F. For higher pressures, specify List 990. Send for illustrated Catalog No. 10.

THE CHAPMAN VALVE MFG. CO., INDIAN ORCHARD, MASS.

TABLE 1. Pertinent data of projections—Well No. 2.

Projection	Current prod. rate 1-1-51	*Rate ratio	*Remaining life	*Remaining reserves	Value current time	Slope	Indicated decline current	Indicated decline final
	B/D	Per cent	Years	1000 bbl	Years		Per cent per year	
A	24.7	26.3	13.4	59.	7.08	—1.26	15.4	6.9
B	24.7	26.3	19.5	82.	5.08	— .85	14.1	3.3
C	25.0	26.0	28.6	114.	4.08	— .65	13.2	2.0
D	24.4	26.6	29.4	119.	4.08	— .62	12.8	1.8
Fig. 3 (constant decline)	25.3	25.7	10.6	53.	....	.....	12.0	12.0
Fig. 4 (variable decline — controlled)	25.3	25.7	15.	70.	13.3	—1.80	12.0	6.0

* To limit of 6.5 B/D.

FIG. 2—WELL 2

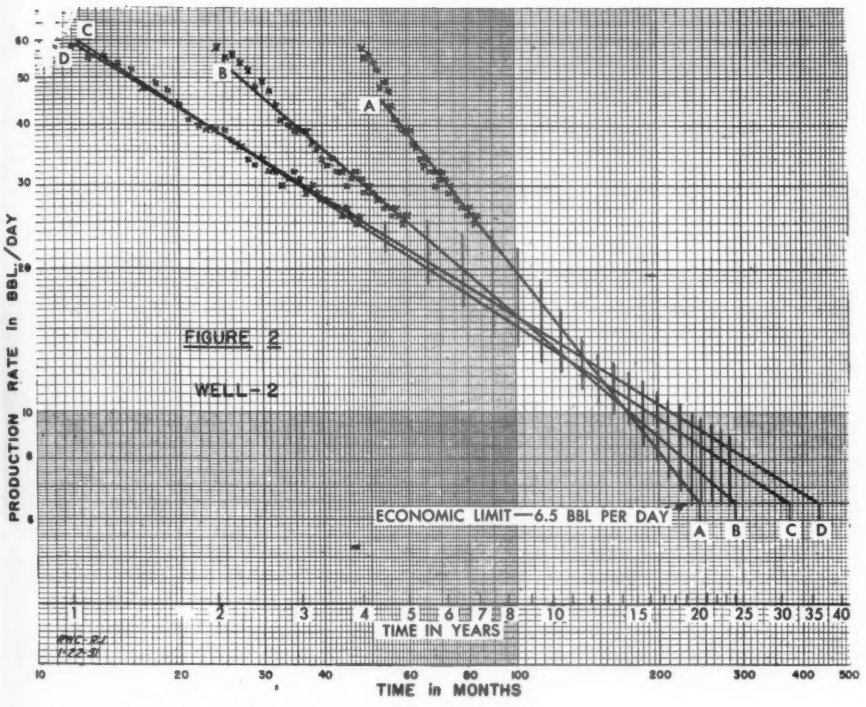
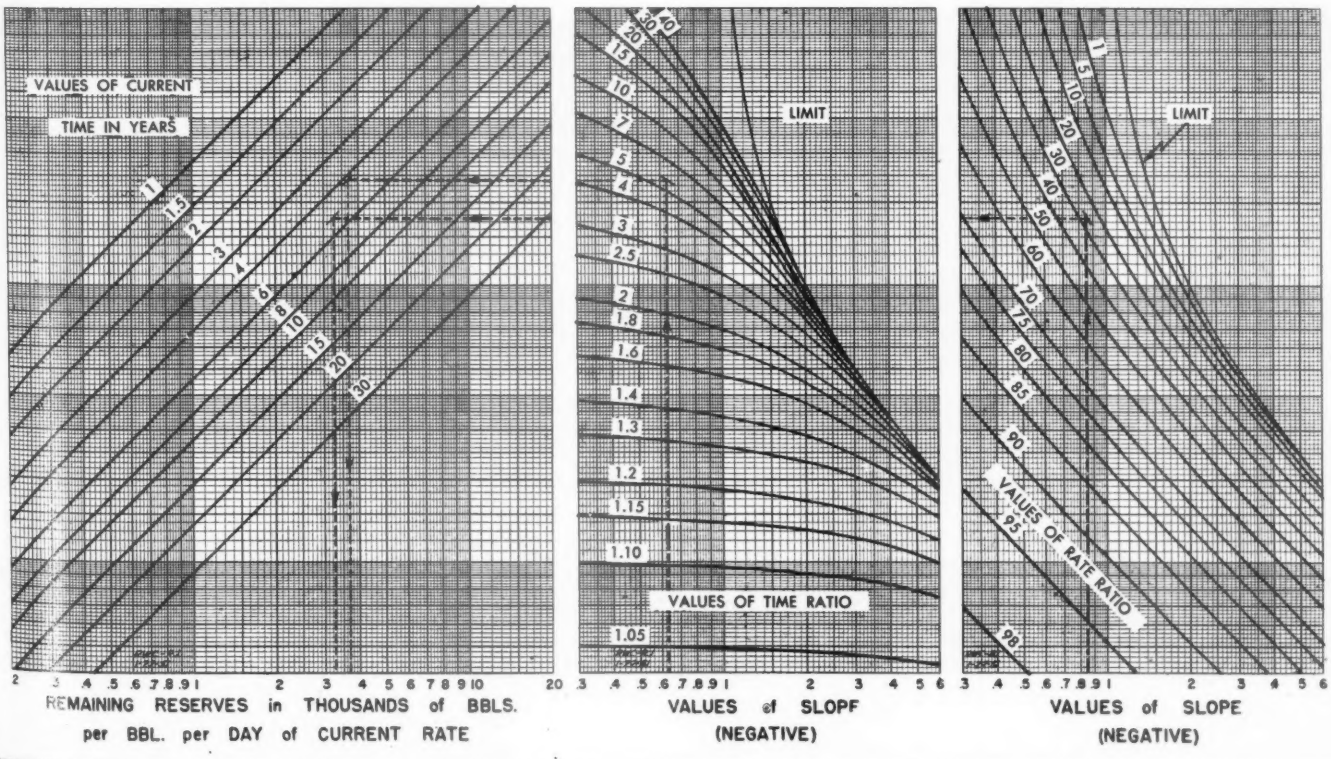


CHART 4



PART 3.

Applications

1. Practical application of rule of constant decline for cases in which a variable decline rate is indicated for remaining life.

For cases in which the decline ratio is 45 per cent or better:

(a) Calculate reserves for approximately first third of remaining life based on current decline rate.

(b) Add the reserves for the balance of the life based on final decline rate.

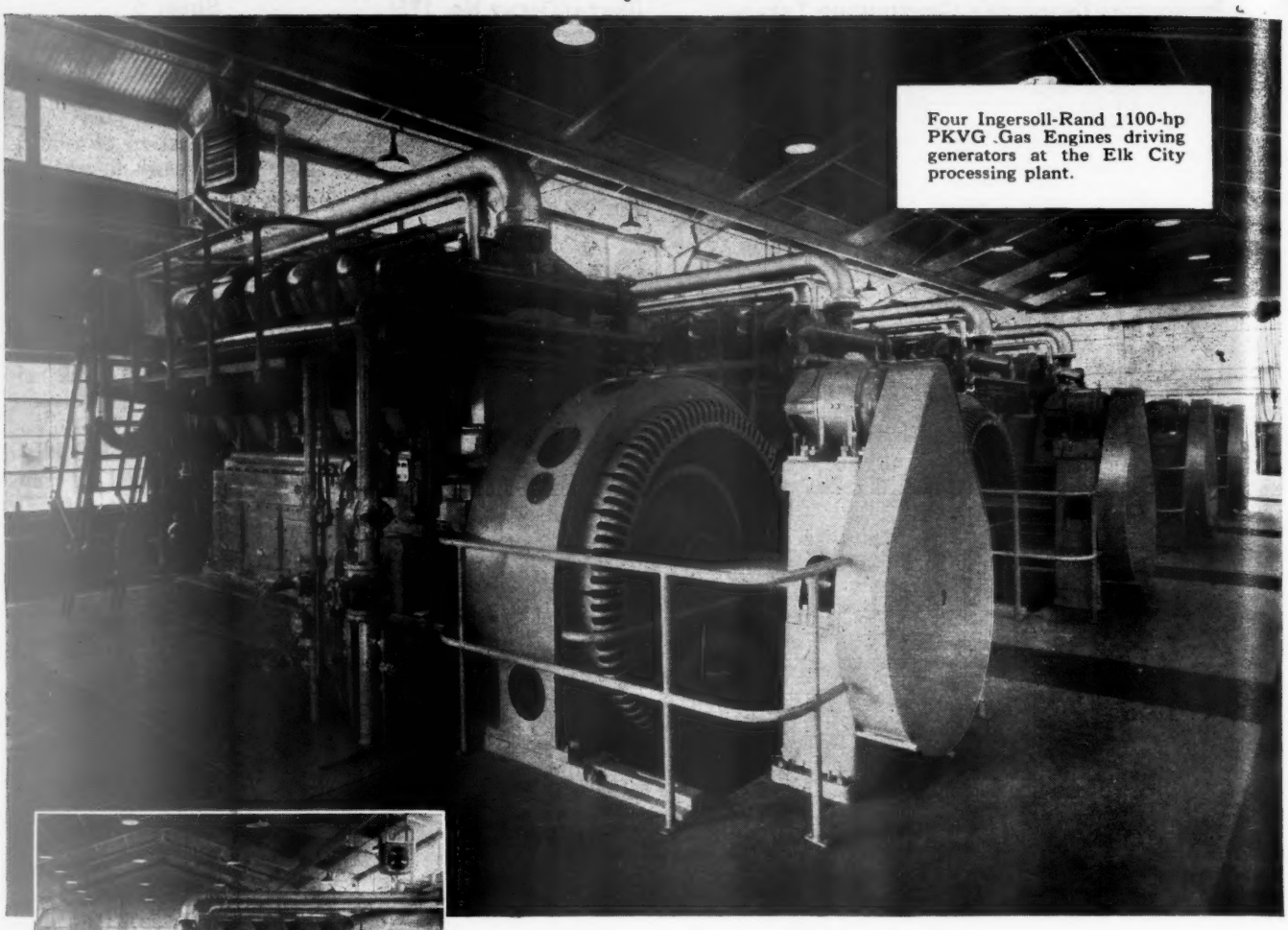
Thus: In Fig. 5, the production trend from Fig. 4 is plotted on semi-log paper. Using the above approximation:

Current production rate	= 25 B/D
Current decline rate	= 12 per cent per year
⅕ remaining life (arbitrary)	= 5 years
Reserves per current barrel (Chart 3)	= 1.35 1000 bbl
Reserves for first 5 years	= 33.8 1000 bbl
Rate ratio (5 year period, from Chart 2)	= 53 per cent
Final decline rate	= 6 per cent per year
Balance of life	= 10 years
Reserves per current barrel (Chart 3)	= 2.75 1000 bbl
Reserves for last 10 years	= 36.5 1000 bbl
$2.75 \times (0.53 \times 25)$	
Total reserves	= 70,300 bbl

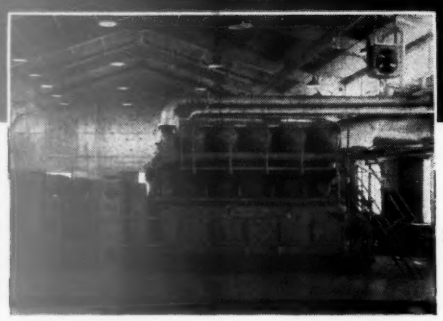
The reserves computed in this manner compare favorably with the previous estimate based on continuously variable decline. Table 2 shows the effect of small changes of decline rates in this example for purpose of comparison.

For lower values of decline ratio, the following divisions of remaining life may be used to achieve reasonably accurate results:

Decline ratio	First portion remaining life
45 per cent plus	1/3
30 — 45	1/4
20 — 30	1/5



Four Ingersoll-Rand 1100-hp PKVG Gas Engines driving generators at the Elk City processing plant.



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All of the electric power at the Elk City Processing Plant is generated by four large PKVG units. Each engine develops 1080 bhp at 1960 feet altitude.

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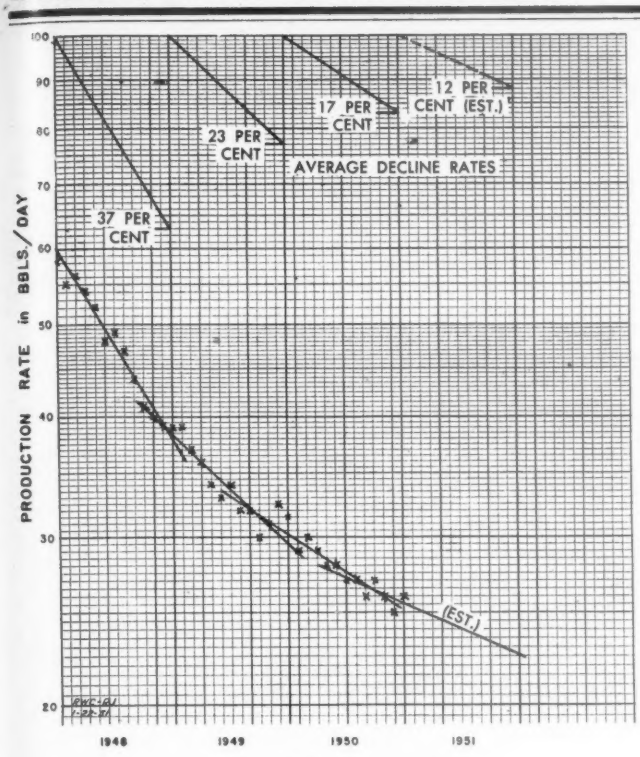


FIG. 3
WELL 2

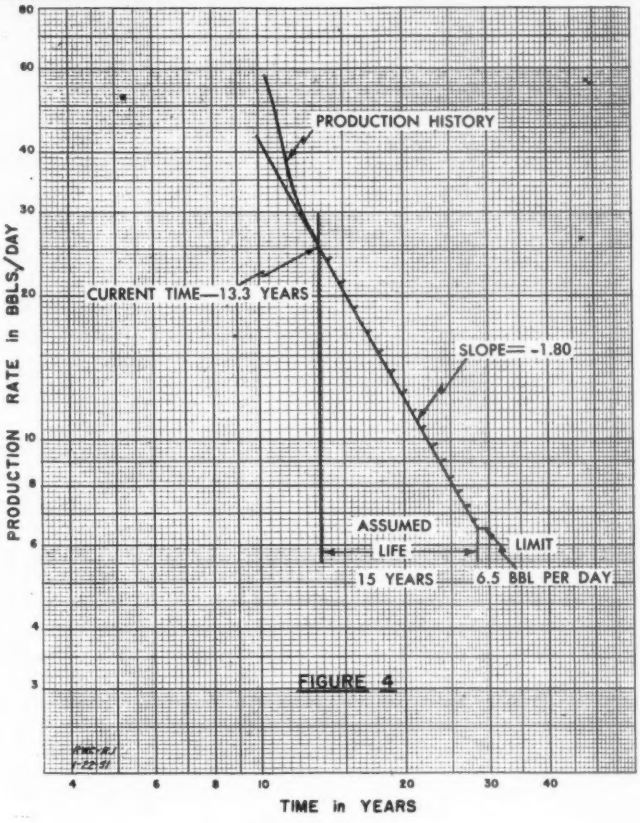
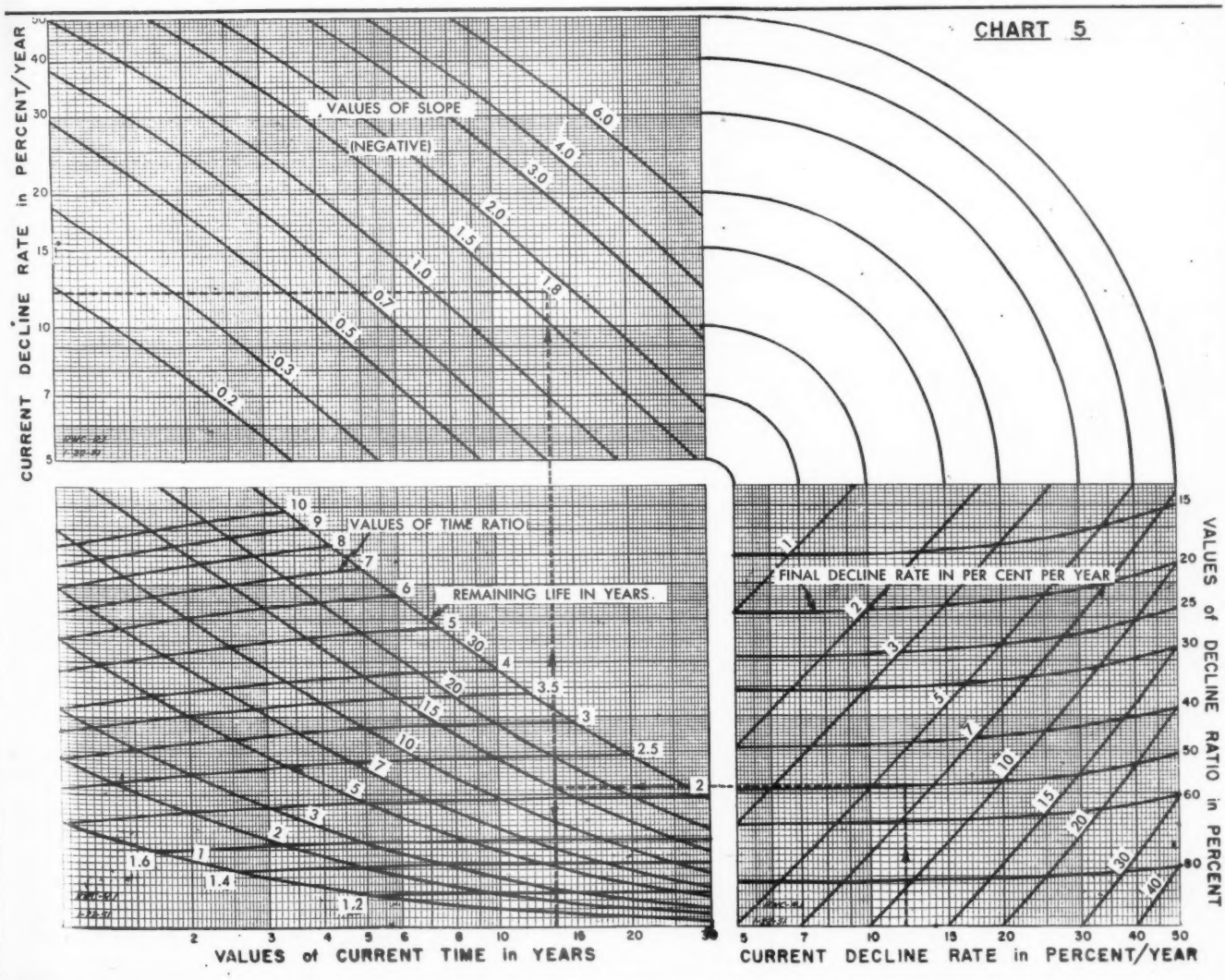
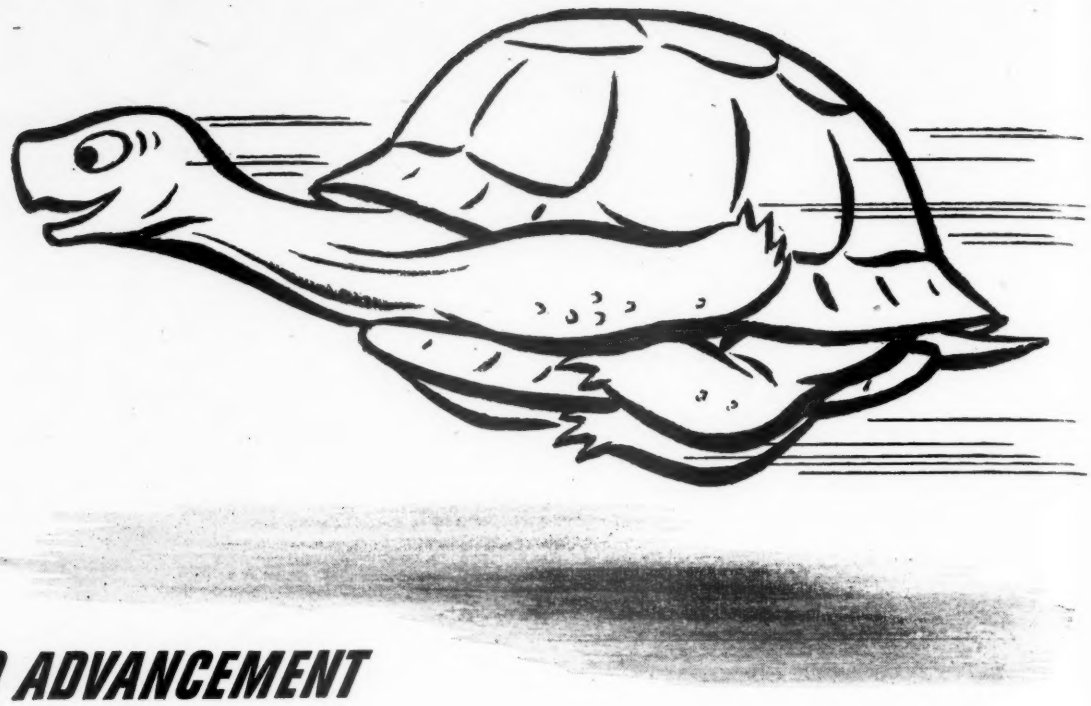


FIGURE 4

FIG. 4

CHART 5





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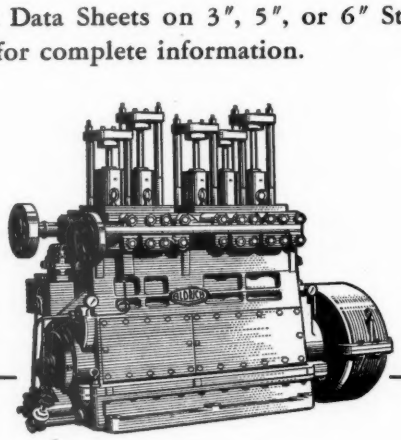
Applications for Aldrich Direct Flow Pumps include: water flooding, salt water disposal, lean oil recycling, and the handling of diethylene glycol, gasoline, propane and butane.

Request Data Sheets on 3″, 5″, or 6″ Stroke Pumps for complete information.



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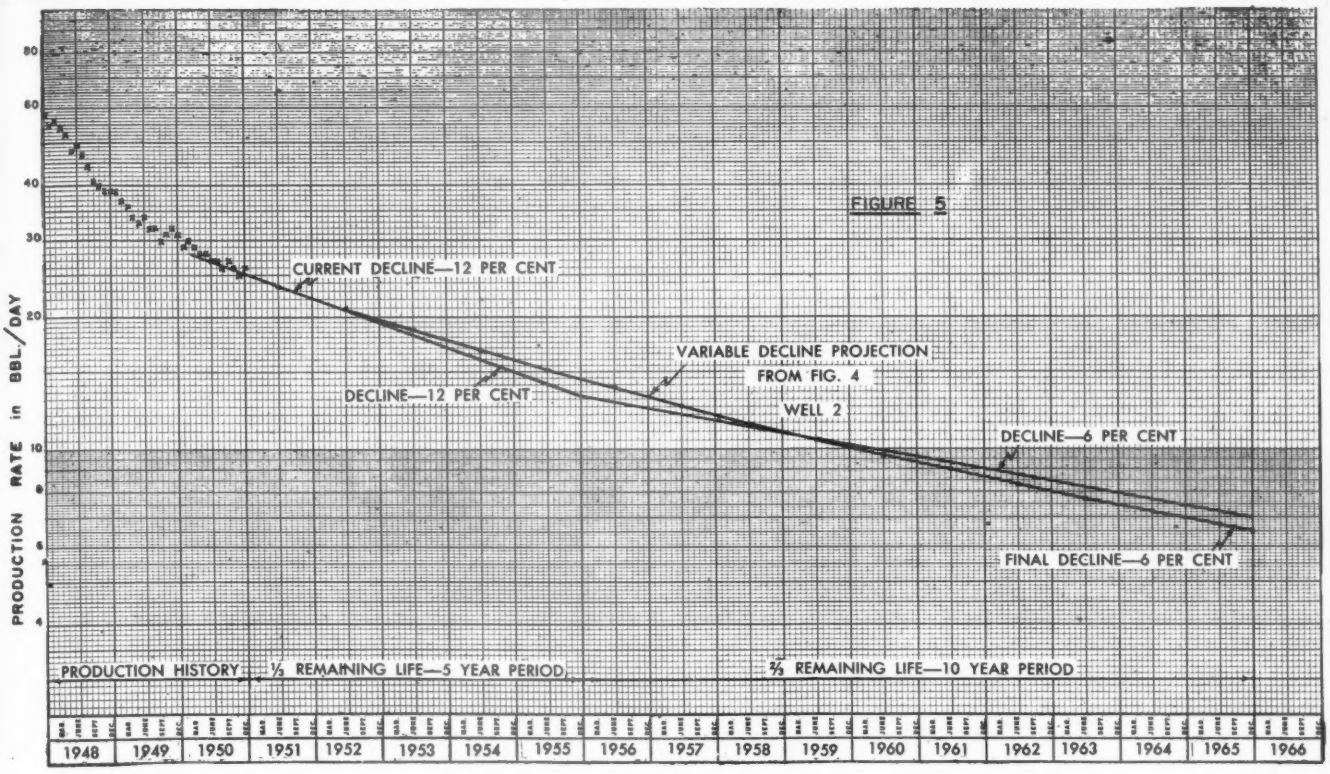


FIGURE 5
CURRENT DECLINE—12 PER CENT
DECLINE—12 PER CENT
VARIABLE DECLINE PROJECTION FROM FIG. 4
WELL 2
DECLINE—6 PER CENT
FINAL DECLINE—6 PER CENT
PRODUCTION RATE in BBL./DAY
PRODUCTION HISTORY
⅓ REMAINING LIFE—5 YEAR PERIOD
⅔ REMAINING LIFE—10 YEAR PERIOD
1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966

FIG. 5

2. Application of rule of constant decline for cases in which a variable decline rate is indicated for a flush period:

a. Estimate reserves for flush period based on variable decline.

b. Estimate reserves for settled period based on constant decline or as in modification (Case 1) above.

Thus, in Fig. 6:

Current production rate	= 130 B/D
Current decline rate	= 35 per cent per year
Assume flush period	= 5 years
Reserves per current barrel (Chart 3)	= 0.74 1000 bbl
Flush base reserves (130 × 740)	= 96. 1000 bbl
Assume decline rate at end of flush period from field experience	= 12 per cent per year
Calculate decline ratio	= 34.2 per cent
From Chart 7[5] series, find additional reserves (Fig. 6 shaded) due to variable decline	= 19 per cent
Calculate additional flush reserves. (96 × .19)	= 18. 1000 bbl
From Chart 7[5] series, find production rate at end of flush period as per cent of current production rate	= 28 per cent
Calculate production rate beginning of settled period (.28 × 130)	= 36 B/D
Assume economic limit	= 12 B/D
Calculate settled rate ratio (12 ÷ 36)	= 33 per cent
Settled period (from Chart 2)	= 8.6 years
Reserves per current barrel settled period (from Chart 3)	= 1.9 1000 bbl
Reserves for settled period (36 × 1.9)	= 68. 1000 bbl
Summarize:	
Economic life 5 + 8.6	= 13.6 years
Economic reserves 96 + 18 + 68	= 182,000 bbl

[5] Based on formulae 6, 7, 10, 11, 12.

Discount to Present Worth—Constant Decline

Chart 6[6] Series—"Discount Factors" relates:

[6] This series is limited to cases in which operating costs and net oil prices are reasonably constant throughout the remaining economic life, and in which capital expenditures are relatively small.

TABLE 2.

5 year period				10 year period			Total reserves
Current decline rate	Rate ratio	Reserves per bbl	Reserves 1000 bbl	Final decline rate	Reserves per bbl	Reserves 1000 bbl	1000 bbl
13	.49	1.31	32.7	5	2.88	35.3	68.0
12	.53	1.25	33.8	6	2.75	36.5	70.3
11	.56	1.38	34.5	7	2.60	36.5	71.0
10	.59	1.42	35.4	8	2.48	36.6	72.0

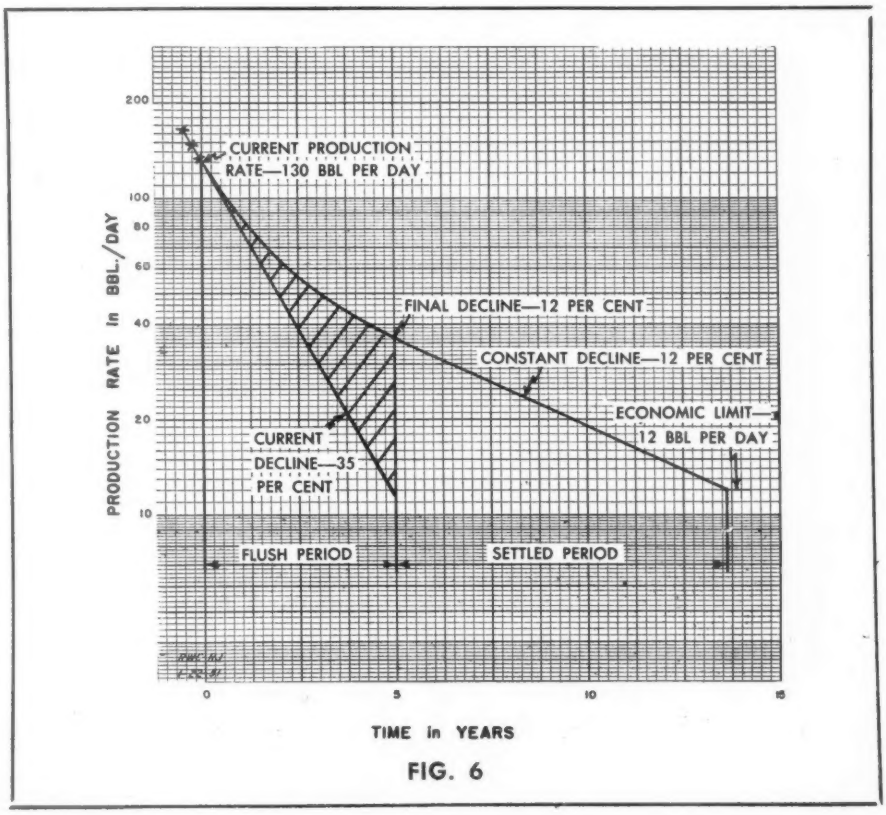
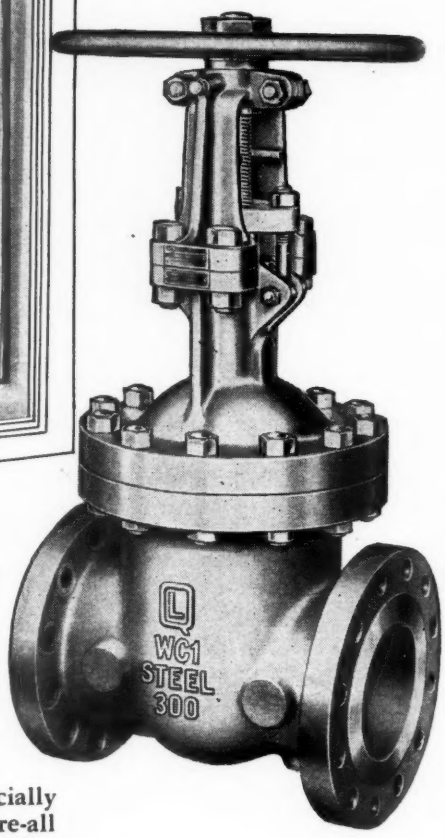


FIG. 6



LUNKENHEIMER "Service-Engineered" Steel Valves Will Meet YOUR SPECIFIC APPLICATION PROBLEMS

MAINTENANCE costs need specialized attention, these days—especially in your field, where steel valves are important. There's no cure-all for your valve maintenance problem. It has to be tackled an installation at a time — service by service — and that's where Lunkenheimer engineering comes in.

Maintenance costs are bound to be high wherever your steel valves aren't *perfectly* suited to the service. To cut those costs, get a *perfect match*. Check the *important* things—trim combinations to insure against galled parts . . . the kind of alloys used for oil service and the different kinds for steam and non-lubricating fluids . . . stem connections . . . gaskets . . . bolts. Lunkenheimer steel valves are designed with a service in mind, and we will supply the correct valve for your *specific* needs.

Call in the Lunkenheimer representative in your area. He'll be glad to put at your command all the generations of successful experience behind Lunkenheimer's complete selection of "service-engineered" steel valves. For his address, write The Lunkenheimer Co., P. O. Box 360H, Cincinnati 14, Ohio.

STEEL • • • IRON • • • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-650-13A

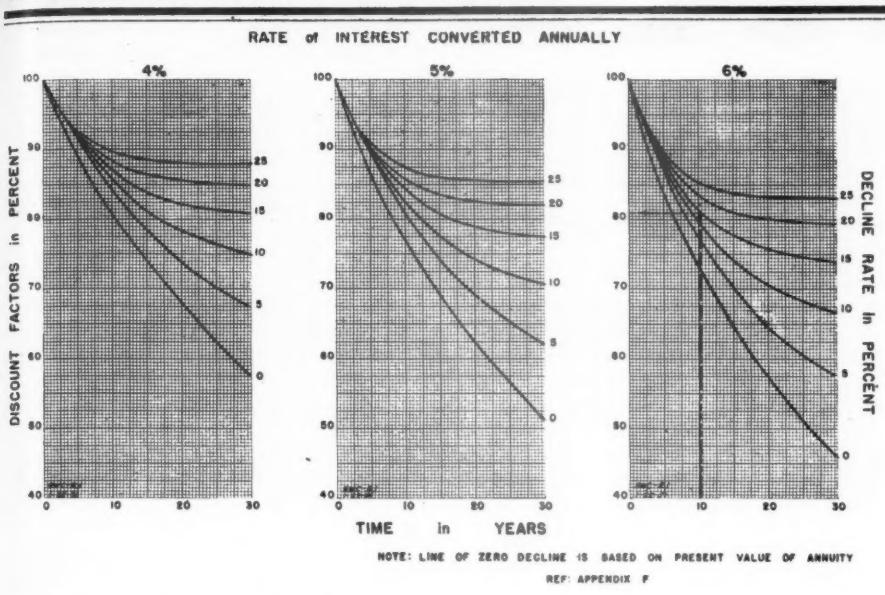


CHART 6

1. Remaining economic life in years.
2. Decline rate in per cent per year.
3. Discount factor in per cent.

Refer to first example in Part 1.

Given:	
Net oil price	$2.00 per bbl
Working interest	80 per cent
Operating costs	$200 per month
Decline rate	15 per cent per year
Interest rate	6 per cent
From Charts:	
Future economic life	10.2 years
Gross future economic reserves	40,300 bbl
Calculate:	
Gross working interest reserves (.8 × 40,300)	32,400 bbl
Working interest—gross income (2.00 × 32,400)	$64,800
Operating costs (10.2 × 12 × 200)	$24,500
Working interest—net income	$40,300
From Chart 6: discount factor	81 per cent
Present worth: net working interest (.81 × 40,300)	$32,600
Present worth: net working interest per barrel future gross economic reserves	$ .81 per bbl

Table 3 outlines the conventional procedure for a similar problem.

APPENDIX A

Symbols		Units
Q	Production rate	B/D
t	Time	years
A	Average production rate at t_1 or "Current Barrel"	B/D
L	Economic or other limit	B/D
T	Time from t_1 to economic or other limit	years
D	Rate of decline at time t	per cent for year
r	Rate of decline at time t	B/D per year
S	Cumulative production from t_1 to t_2	bbl
I	Working interest	per cent
P	"Net" oil price: Oil price plus and minus revenue and expense reduceable to per barrel basis	$/bbl
C	"Net" operating expense applicable on time basis	$/Mo.
i	Interest rate	decimal
R	Discount factor	per cent
U	"Decline ratio": $D_2 \div D_1$	
V	"Time ratio": $t_2 \div t_1$ or $(t_1 + T) \div t_1$	
W	"Rate ratio": $Q_2 \div Q_1$ or $L \div A$	
d	Decline factor: d=1—0.01 D	
d'	"Discounted" decline factor: $d' = \frac{d}{1+i}$	
K	A constant	
n	A constant	

APPENDIX A

Tabular Values of .365(—Ind)

D		D	
1	36.3	20	1.636
1½	24.15		
2	18.07	22	1.469
3	11.98	24	1.330
4	8.94	25	1.269
5	7.12	26	1.212
		28	1.111
6	5.90	30	1.023
7	5.03		
8	4.38	32	.946
9	3.87	34	.878
10	3.46	35	.847
		36	.818
11	3.13	38	.763
12	2.855	40	.714
13	2.621		
14	2.420	42	.670
15	2.246	44	.630
		46	.592
16	2.094	48	.558
17	1.959	50	.527
18	1.839	60	.398
19	1.732		

TABLE 3. Conventional evaluation.

	Estimated production			Working interest				
	Average B/D	Gross bbl	Net W.I. bbl at 80 per cent	Gross income at $2.00	Oper. expense at $200.	Net income	Discount factor	Present worth
1951	20.2	7370	5900	$11,800	$2,400	$9,400	.943	$8,860
1952	17.2	6280	5020	10,040	2,400	7,640	.890	6,800
1953	14.6	5330	4260	8,520	2,400	6,120	.840	5,140
1954	12.4	4530	3620	7,240	2,400	4,840	.792	3,830
1955	11.4	4160	3330	6,660	2,400	4,260	.747	3,180
1956	8.9	3250	2820	5,640	2,400	3,240	.705	2,280
1957	7.5	2740	2190	4,380	2,400	1,980	.665	1,320
1958	6.4	2340	1870	3,740	2,400	1,340	.627	840
1959	5.4	1970	1580	3,160	2,400	760	.592	450
1960	4.6	1680	1340	2,680	2,400	280	.558	160
1961 (6 2)	4.6	340	270	540	480	60	.527	30
		39,990	32,200	$64,400	$24,480	$39,920		$32,890

APPENDIX B

Equation for Economic Limit

1. Basic equation:

$$L = \frac{C}{30.4} \times \frac{100}{PI}$$

Where		Units
L	= Economic or other limit	B/D
P	= "Net" oil price: oil price plus & minus revenue and expense reduceable to per barrel basis	$/B
C	= "Net" operating expense applicable on time basis	$/Mo.
I	= Working interest	per cent

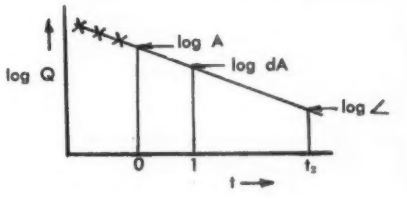
APPENDIX C

Production Rates in B/D of Wells In Illustration

		Well No. 1	Well No. 2
1947	December	36	58
1948	January	37	55
	February	35	56
	March	33	54
	April	34	52
	May	33	48
	June	33	49
	July	34	47
	August	32	44
	September	33	41
	October	29	40
	November	30	39
	December	28	39
1949	January	29	39
	February	31	37
	March	29	36
	April	30	34
	May	28	33
	June	28	34
	July	29	32
	August	27	33
	September	28	30
	October	26	31
	November	25	32
	December	26	31
1950	January	27	29
	February	24	30
	March	26	29
	April	24	28
	May	26	28
	June	24	27
	July	25	27
	August	23	26
	September	23	27
	October	22	26
	November	21	25
	December	22	26

APPENDIX D

Derivations—Constant Decline



Let

Q = Production rate at time t in barrels per day,

A = Production rate when $t_1 = 0$

t = Time in years,

d = Decline factor as defined: $d = 1 - D \times 10^{-2}$ in which,

D = Rate of decline in per cent per year.

Assume constant slope M of straight line above:

$M = -(\log A - \log dA) \div 1$ or $\log d$.

Equation for straight line:

$\log Q - \log A = \log d\,(t - O)$ and

LAUGH with BARNEY

A clergyman was spending the afternoon at a house in the English village where he had preached. After tea he was sitting in the garden with his hostess. Out rushed her little boy, holding a rat above his head.

"Don't be afraid, mother," he cried, "it's dead. We beat him and bashed him and thumped him until" — and then catching sight of the clergyman, he added, in a lowered voice—"until God called him home."

* * *

The new twins had arrived, and Dickie from the vantage point of three grown years, was watching their feedings with particular interest. Throughout the day, each time the infants were fed, Dickie would stand first by the side of his mother, and then he would go to the kitchen, where his father was patiently giving the other twin her bottle.

Finally at supper time, after a day spent in silent and solemn observation, Dickie dashed to his mother and excitedly exclaimed, "Mommy! Daddy's doing it wrong!"

* * *

"Lady, if you'll give us a nickel my little brother will imitate a chicken."

"What will he do?" asked the lady, "cackle like a hen?"

"Naw," replied he boy in disgust. "He wouldn't do a cheap imitation like that—he'll eat a worm."

A well known columnist tells of someone watching some kids who were playing Wild West. One had made a bar of a packing box and scrawled a sign on it: "This is the Wild West and this box is the Last Chance Saloon."

Another kid swaggered up, pounded the bar and cried: "I'll have a rye."

A third, much younger, and apparently less sophisticated swaggered up alongside him and squeaked: "I'll have a whole wheat."

* * *

The Blood Collection Center, during war days is a very busy place. One lady, a volunteer aide, was rushing out of the room with a container of freshly drawn blood when she encountered a colonel who was a regular donor.

Recognizing each other immediately, the lady greeted him cheerily: "Just jump into bed, Colonel, I'll be with you in a minute."

* * *

Yachtsman: If this squall continues I will have to heave to.

Lady Guest: My, what a horrible way to put it."

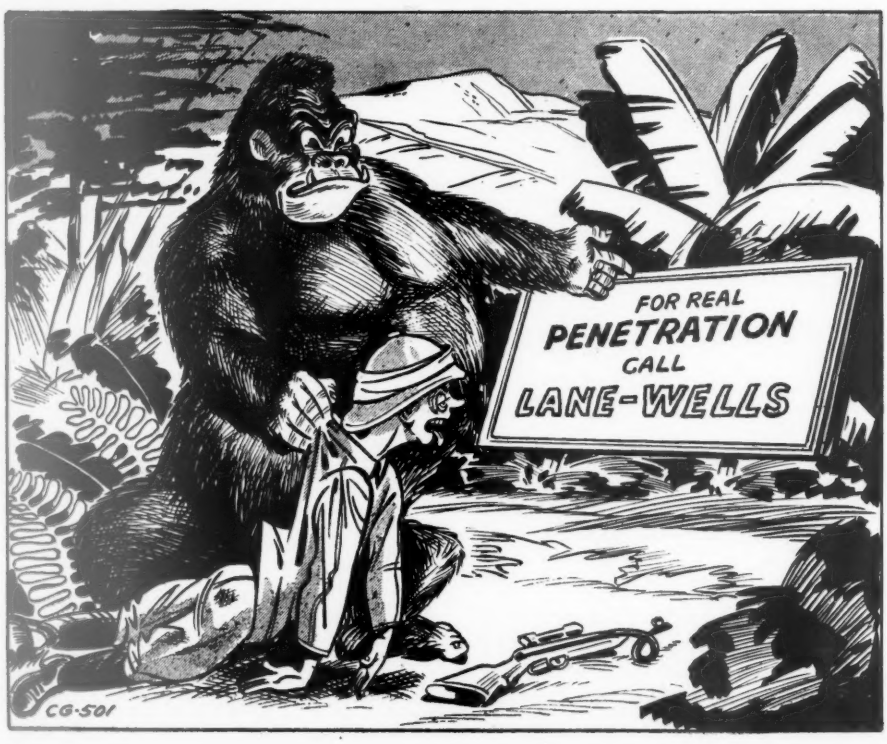
* * *

"What's your name?"

"Thomas Jefferson."

"That's a pretty well known name."

"It ought to be. I've delivered milk in this town for three years!"



Tavern: Place which a man enters optimistically and exits misty optically.

* * *

The absent minded professor called his biology class to order just after the lunch hour. "Your assignment for this afternoon," he said, "will be to dissect a frog which I have in this sack." He held up the sack for the class to see.

Upon shaking out the contents a delicious looking sandwich was revealed. Looking puzzled, the professor mumbled, "Now I wonder whose lunch I could have eaten?"

* * *

"And what were your husband's last words?"

"He said, 'I don't see how they make a profit out of this stuff at a dollar and a quarter a quart'."

* * *

"He was sent upstairs to bed for swearing something terrible," young Johnny's mother explained for the boy's absence at the dinner table.

"Swearing something terrible," the man of the house boomed, "I'll teach him to swear!" whereupon he rushed up the stairs, stubbed his toe on the top step and fell flat on his face on the landing.

When the air had cleared a little the Mrs. said sweetly, "No more now, dear. you've given him enough for one lesson."

* * *

"How did your brother die?"

"He fell through some scaffolding."

"What was he doing up there?"

"Being hanged."

* * *

Johnnie had worked hard to earn enough money to buy a new bicycle, but lacked $20 having enough, so he wrote a letter asking God to send him the $20.

The letter went to the dead letter office in Washington, where it was opened and a kindly postal employee put a $5 bill in a government envelope and mailed it to Johnnie.

When Johnnie received the envelope and looked at the bill, he sat down to write another letter to God. "Dear God, thank you for the money, but next time don't send it through Washington. They took out $15 for taxes.

* * *

"John dear, I wouldn't let anyone else kiss me like this."

"My name isn't John."

* * *

Alcatraz: The pen with the lifetime guarantee.

* * *

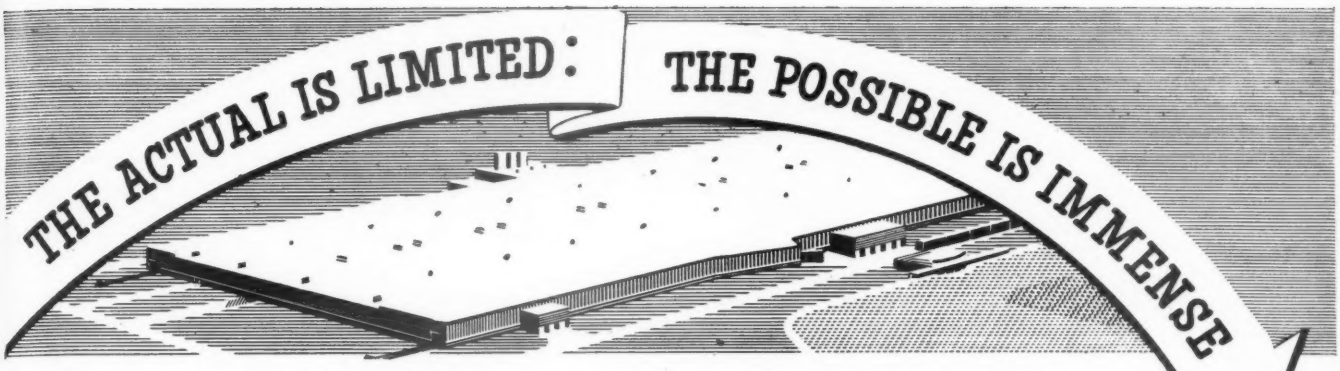
A tourist seeking an ideal southern town stopped in Jackson and asked an old timer if the place was healthy.

"Healthy?" the old man roared.

"Why this is the gol' darn healthiest place you ever did see. Shucks, nobody ever dies in these parts."

"That's strange," remarked the tourist. "On my way into town I passed a funeral procession."

"Oh that," the old timer grunted. "That was only the undertaker. The darn fool starved to death."



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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MOBILE UNIT DOUBLE JOINTING SPEEDS PIPE LAYING

By: **EDWIN G. HILL**
Vice-President, HILLCO, Inc.,
Tulsa, Oklahoma

AN average of eight 26″ double-jointing welds per hour are being completed with the new mobile machine. One crew first aligns the pipe with an internal clamp and runs the manual root bead. The pipe is then picked up and placed on turning rolls for final welding by the mobile unit using "Manual Lincolnweld" arc welding in granular flux. Welding speed is 36 inches per minute for each of two passes. The final weld, ⅝″ to ¾″ wide, is slightly convex with feather edge appearance at the junction of the pipe.

Mounted on a diesel tractor, the mobile double jointing unit is equipped with a 600 amp. Lincoln "Shield-Arc" generator direct driven from the tractor power takeoff. The "Manual Lincolnweld" unit itself is mounted on a platform attached to the tractor, and is hydraulically elevated to accommodate various pipe levels. Unused granular flux is salvaged by a vacuum flux recovery unit.

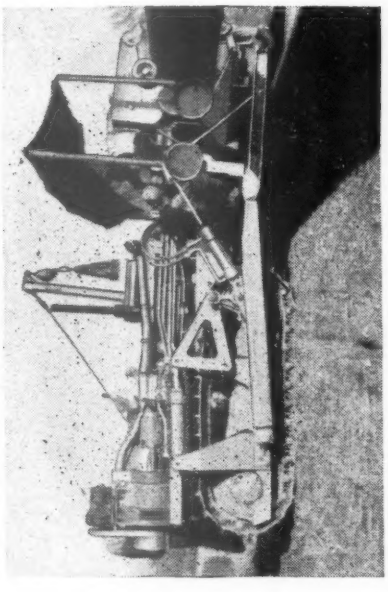


Fig. 3. Mobile double-ender *used on the Oklahoma Natural Gas 26″ pipe line. Built by HILLCO, Inc., Tulsa, Oklahoma, it produces 60 to 70 thirty-inch pipe welds per day.*

CUTS WELDING COSTS 25%

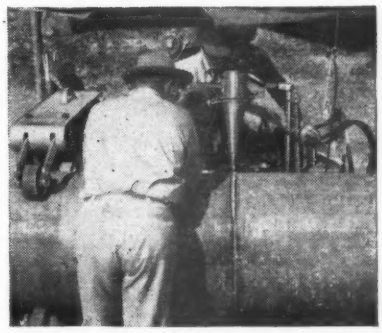


Fig. 1. Double jointing *26″ pipe along the right of way with "Manual Lincolnweld". Cuts costs of welds by 25%.*

SAVES 40% ON ELECTRODES

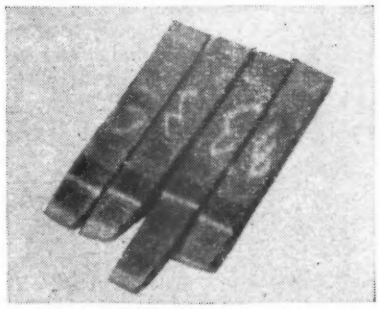


Fig. 2. Hidden arc welding *in granular flux assures uniform quality on every joint when checked by X-rays.*

WELDS 4 TIMES FASTER

Send for Bulletin 1303 "Manual Lincolnweld". Write to Dept. 182,

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 17, OHIO

OIL AND GAS TRADE NEWS

Glitsch Meets in Chicago

Fritz W. Glitsch and Sons, Inc., Dallas, Texas, engineers and manufacturers of Truss-type bubble trays, bubble caps, complete fractionating towers, and other fabricated equipment for processing industries, held its annual sales meeting in Chicago during the American Petroleum Institute convention. Glitsch representatives at the meeting were Allan C. Perssons, Gordon W. Lindskog, Julian J. Tunno, and Robert L. Allen. Other Glitsch executives attending the meeting but not available for the picture: H. C. Glitsch, M. C. Glitsch, K. E. Luger, S. G. Higginbotham, and R. W. Fowler.

Representatives of Fritz W. Glitsch and Sons., Inc. meeting in Chicago recently for its annual sales meeting in conjunction with the API.

B & W Tube Transfers Stock

The Babcock and Wilcox Tube Company has transferred its assets and business to The Babcock and Wilcox Company, its sole stockholder. The business will continue to be operated as the tubular products division of The Babcock and Wilcox Company.

Service Men Meet

Field service representatives from the Cleveland, New England, New York, and Philadelphia sales division of Oakite Products, Inc., manufacturers of specialized cleaning materials, are shown in accompanying photo at a series of technical-sales conferences at the Hotel Statler in New York City recently. Featured subject of discussion at these meetings was the major role that cleaning and allied procedures must play in helping industry meet increased defense and civilian production requirements. Also heard were reports from Oakite research chemists, service engineers, and technicians on new developments in cleaning and related materials soon to be made available to industry.

BS&B Opens Two Offices

Henry A. Ruysser, Jr., vice president and general sales manager of Black, Sivalls and Bryson, Inc., Kansas City, Missouri, has announced the opening of another new California sales office at San Francisco. Announcement was recently made of the opening of a Los Angeles Office. Ross Baze, West Coast sales manager, Los Angeles, will be in charge of the San Francisco office, locally assisted by Warren J. May, sales engineer. May, a graduate from Iowa State, was formerly a project engineer for Panellit, Inc., Chicago.

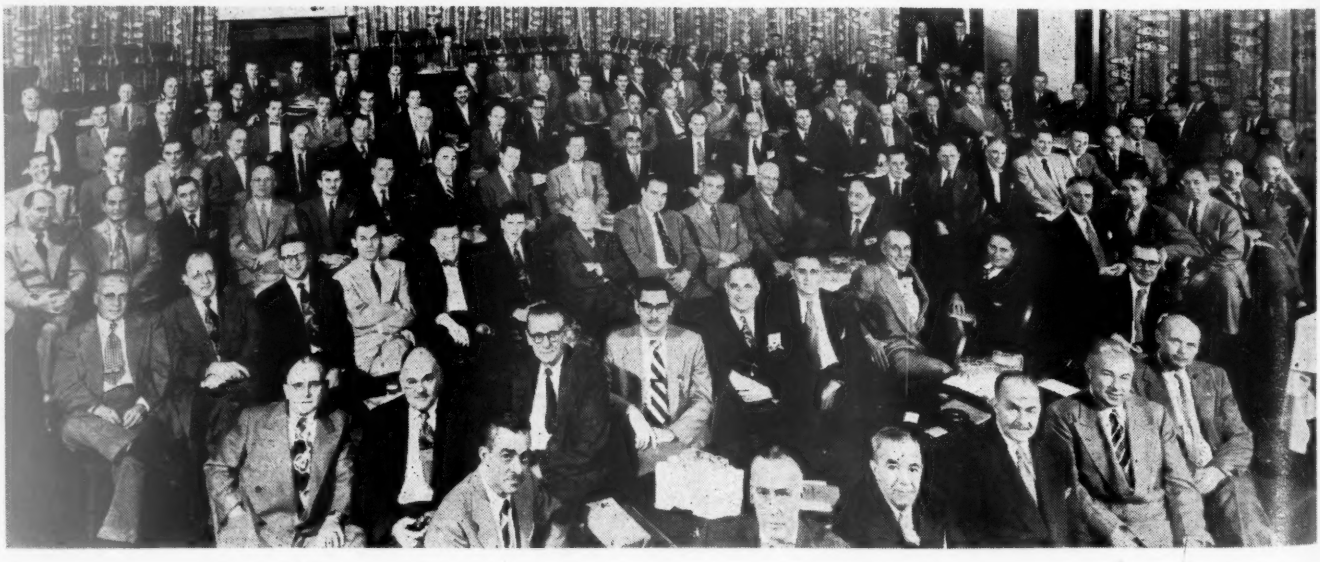
Also announced by Ruysser was the opening of a BS&B Wichita Falls, Texas, office. L. M. Petrie, who will be in charge of the new office, is a graduate of Oklahoma A&M. He was first employed in the BS&B Kansas City engineering department, and was later transferred to Odessa, Texas, then Nocona.

Griscom-Russell Welcomed

The Chamber of Commerce of the City of Massillon, Ohio, gave a "get-acquainted" dinner party at the Massillon Club recently to welcome the executives and key personnel of The Griscom-Russell Company who had recently settled in the city. The occasion of the dinner was the recent removal of the Griscom-Russell administrative sales and engineering departments from New York City to Massillon for most efficient handling of the company's extensive business in the design and manufacture of heat transfer apparatus.

The move of the Griscom-Russell staff to Massillon centralizes the operations of the company at this location. An office building at the company's plant, which is one of the largest in Massillon, is now nearing completion to accommodate the executive, administrative sales, and engineering offices.

Field service representatives of Oakite Products, Inc., in New York City.



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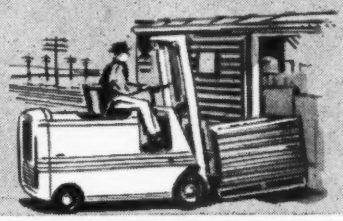
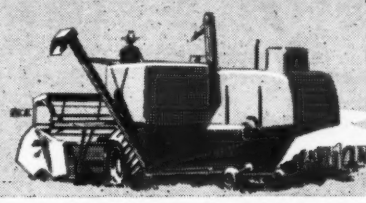


In Industry, Chrysler Powers
Air Compressors • Hoists • Derricks • Pumps • Generators • Tractors • Arc Welders • Baling Machines • Conveyors • Tackle Blocks • Winches

Chrysler Industrial Engines Do a Better Job at Lower Cost!



In Farming, Chrysler Powers
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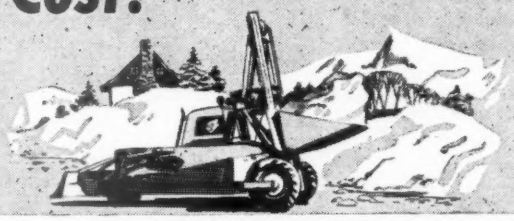

In Other Fields, Chrysler Powers
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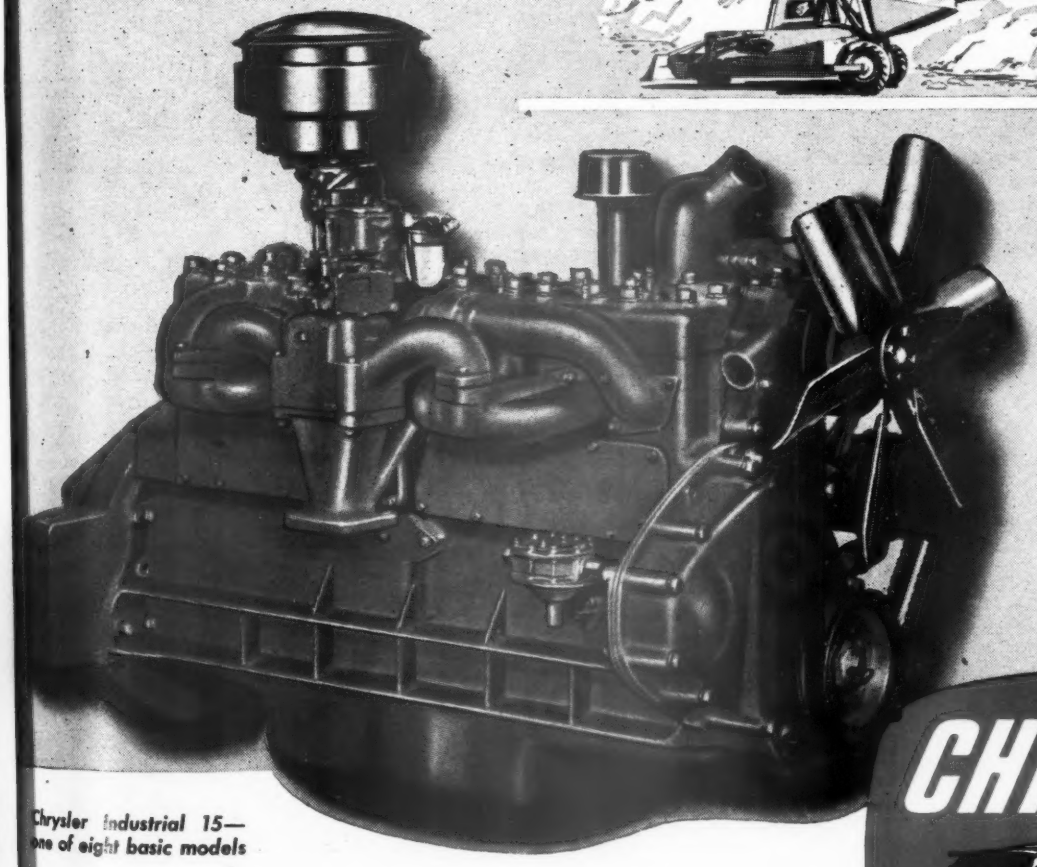


Chrysler Industrial 15—one of eight basic models

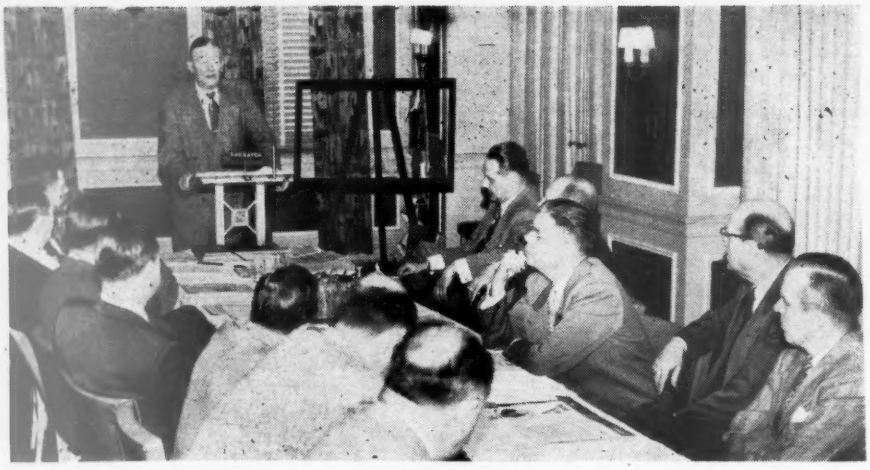
More manufacturers, more operators of industrial equipment are discovering the brilliant efficiency of Chrysler Industrial Engines on scores of different applications.

For Chrysler Industrial Engines are built *solely for industrial jobs.* Furthermore, Chrysler Industrial Engines are designed and engineered to meet the *specific working requirements* of each type of equipment they power. They can also be adapted to special regional operating conditions.

A letter of inquiry will bring an engineer well qualified to discuss your particular application. Address: *Industrial Engine Division, Chrysler Corporation, Detroit 31, Michigan.*

CHRYSLER

HORSEPOWER WITH A PEDIGREE



New York Belt distributors in round table discussion.

New York Belting and Packing Holds Annual Meeting

New York Belting and Packing Company has initiated a new type of general meeting for its distributors — a round table session where the distributors do the talking and the manufacturer does the listening. The first of these meetings was held November 27 in Chicago for New York Belt's distributors in the central states. Thirteen distributors handling the New York Belt line of hose, belting, packing, and other industrial rubber products, elected their own chairman and selected their own topics for discussion. B. F. Ruether, vice president of the company, began the meeting with a few brief remarks. From then on, it was a distributor's show. More are planned for other sections during the year.

Distributors represented were: All-rubber Products and Supply Company, Fort Wayne Pipe and Supply, A. L. Holcomb Company, Indianapolis Belting and Supply, Midwestern Rubber, Northern Supply, W. S. Nott Company, Orr Iron, Semmelmeyer Company, Shields Rubber Company, Uland Rubber and Supply, and Welton Rubber and Asbestos Company.

Whitney Chain Expands

Construction is progressing rapidly on the modern, one-story plant addition of Whitney Chain Company, Hartford, Connecticut. According to W. H. Whitney, president, the building program has been dictated by the tremendous demand for the company's roller and silent chain products, which is taxing available capacity. The new building, which is expected to be in use in several weeks, contains approximately 10,000 sq ft of additional floor space. This area will be devoted to the manufacture of fabricated steel sprockets and the large pitch roller and conveyor chains.

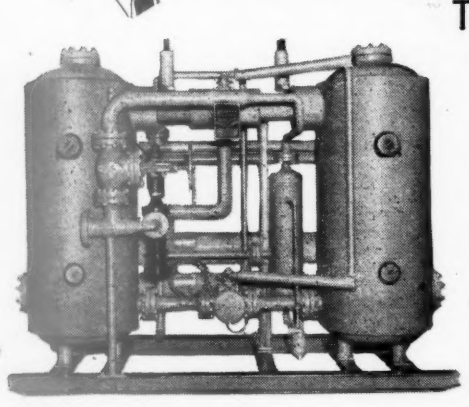
New Guaranty Offered

Charles A. Winslow, president of Winslow Engineering Company, has announced a new guaranty offered by the company. Backed by the company's written warranty that it will not only make good on any of its own products if they have any defects in material or workmanship, the guaranty also covers any engines or other equipment that are damaged as a result of these defects.

Holder of many of the original basic patents covering full-flow in-line filtration principles and devices now increasingly used throughout the industry, Winslow declared that to the best of his knowledge the new warranty affords more complete protection to the engine operator than has been underwritten by any filter or element manufacturer.

It's UNEXCELLED
FOR DEPENDABLE DEHYDRATION!

The Quality Pritchard
HYDRYER*



The Quality Pritchard HYDRYER* is *unexcelled* for dependable dehydration of air and other gases for instrument and process controls. Dual adsorbers provide continuous drying action. HYDRYER* is standard, packaged unit designed to reduce dew points to minus (−) 40°F. Only service connections are required. Specially designed HYDRYER* units can be tailored to meet your individual requirements.

*Registered Trade Name

Cooling Towers
Gas & Air Treating
Specialized Heat Exchangers

Producers of QUALITY Specialized Process EQUIPMENT

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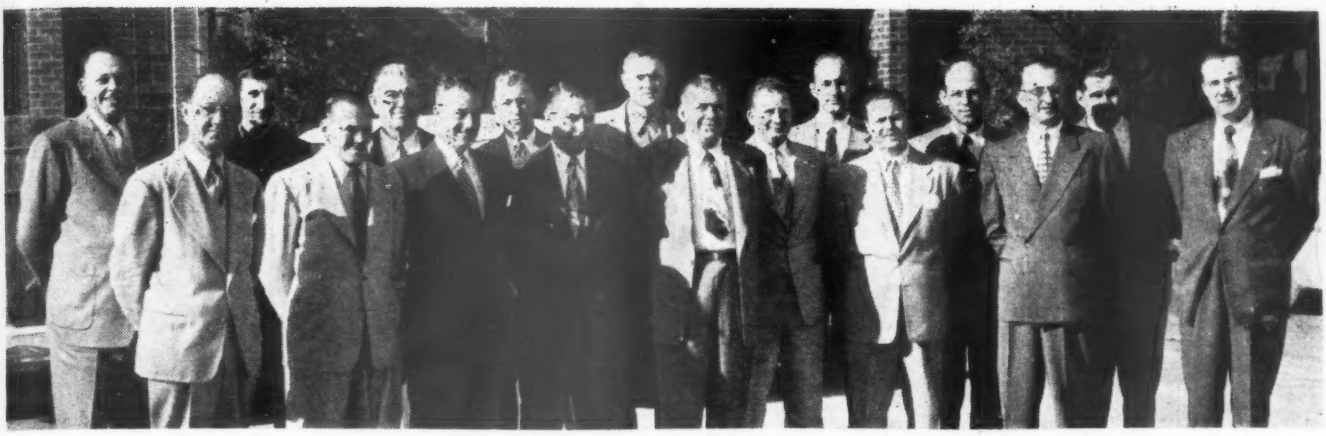
THE MERCURY SWITCH IS A FEATURE IN MERCOID CONTROLS THE REASON FOR THE MERCURY SWITCH IS THE ADDED SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE—ALL OF WHICH ARE IMPORTANT WHEREVER CONTROLS ARE REQUIRED
WHY CONSIDER LESS WHEN YOU CAN GET SO MUCH MORE

WRITE FOR COMPLETE CATALOG

THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.



Sales, executive, and engineering men of Charles Wheatley and Frank Wheatley Pump and Valve in Tulsa.

Wheatley Group Meets In Tulsa, Oklahoma

The Charles Wheatley Company sales group and the executive and engineering department of the Frank Wheatley Pump and Valve Manufacturers, held a sales meeting at Tulsa, Oklahoma, recently. Charles Wheatley was the host company.

Shown at the meeting are: Front row, Fred King, "Hank" Abernathy, Frank Wheatley, L. J. Patterson, "Dick" Hellinghausen, H. D. Richardson, Orbie Sumner, Frank Wheatley, and Frank Wheatley, Jr., executive vice president, Frank Wheatley Company; Huber Dye, and James H. Withers.

Back row, W. E. Wagner, Lloyd Gray, R. U. Hackenjos, R. E. Bleigh, John Fitzpatrick, Harold Putnam, John Burris, Frank Wheatley, Pump and Valve Manufacturers, and Tim Kirk.

New Type Cement Plant Built by Republic Supply

With the completion of a 10,000 ft bulk cement plant at Seagraves, Texas, the manufacturing division of The Republic Supply Company of California introduced an advanced type of cement mixing machinery that should be of interest to the entire trade, according to A. G. Fraser, Republic Supply's vice president in charge of manufacturing. In the new plant, which is owned by B-J Service, Inc., (formerly International Cementers, Inc.) Republic Supply's engineers have incorporated special features in the mixing and conveying machinery that put cement mix formulas completely under the control of the operators. In addition, there are screw-type or helicoid conveyors that can force the mix from lower levels to higher at the rate of 60 cu ft per minute.

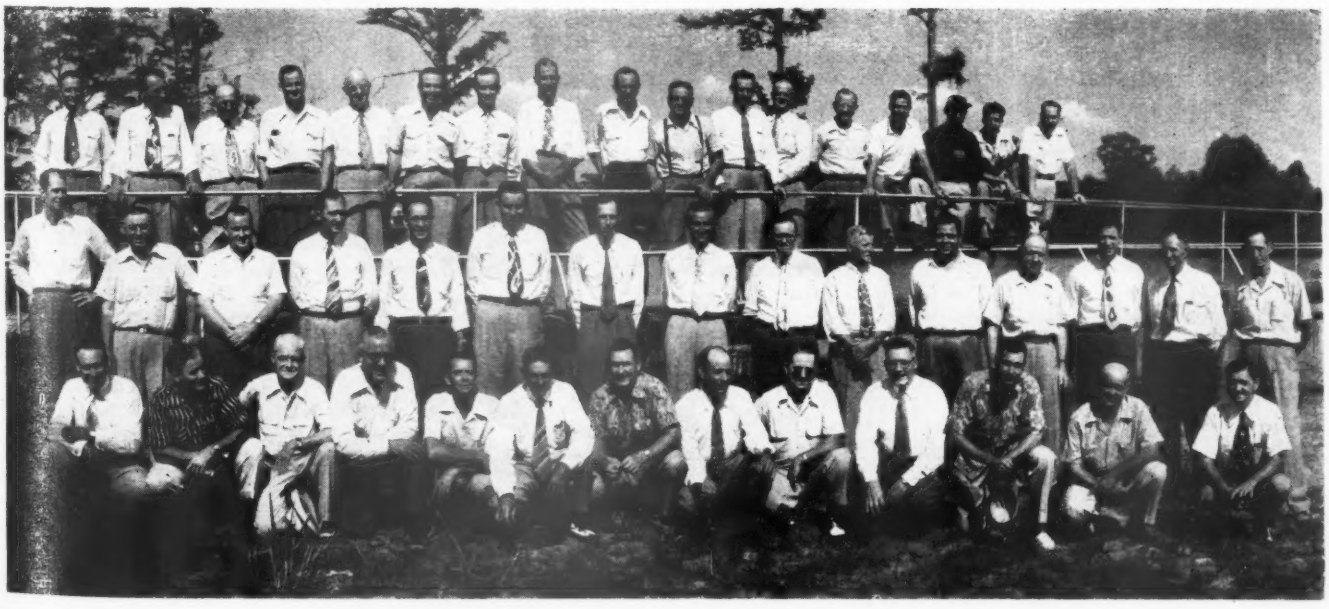
Chicago Sales Office Open

The Pittsburgh Coke and Chemical Company, Pittsburgh, Pennsylvania, has announced the opening of an office at 75 East Wacker Drive, Chicago, Illinois, to direct the sale of the company's industrial protective coatings in the Midwest. Joseph R. Robinson will be in charge of the sale of pipe line enamels and the sale of synthetic coatings will be under Ralph G. Mensch.

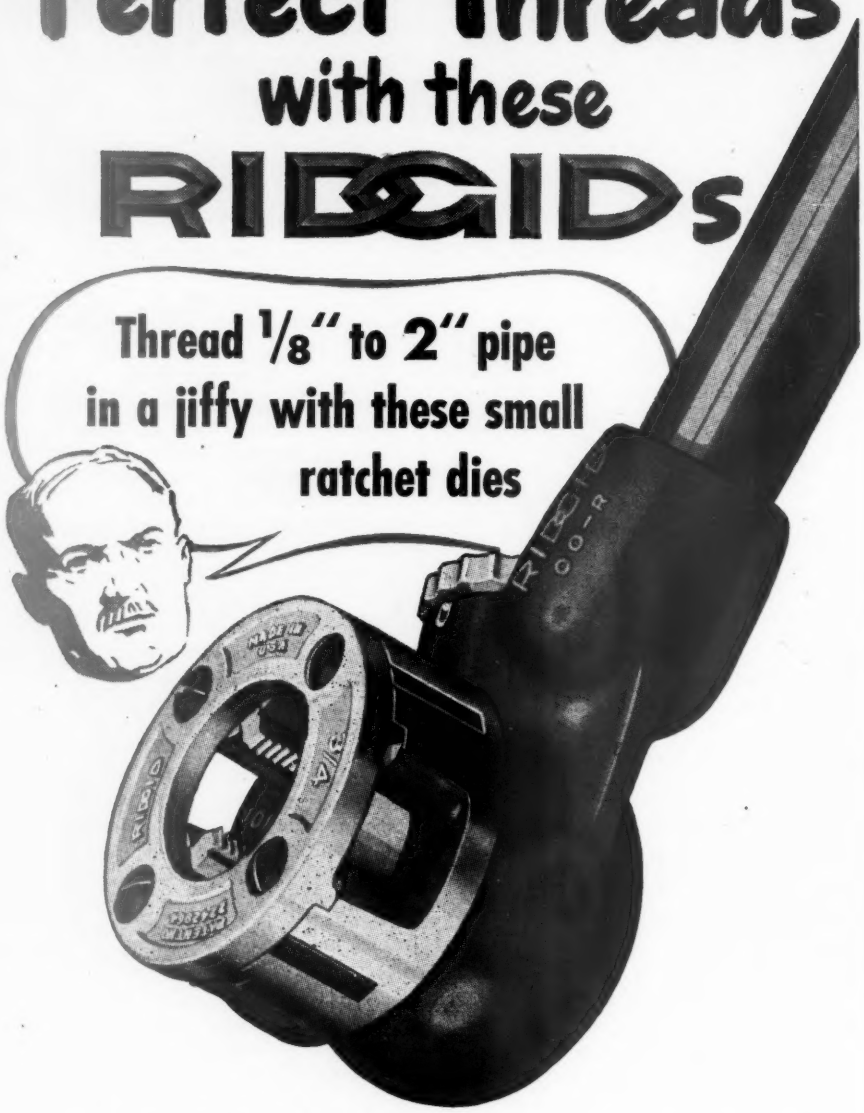
Forms Canadian Subsidiary

Herbert Allen, vice president and general manager of Cameron Iron Works, Inc., Houston, Texas, has announced the organization of Cameron Iron Works of Canada, Ltd. The new subsidiary company will distribute Cameron products to Canadian oil operators operating in Canada. N. G. Loudoun is sales representative in Canada.

Attending Superior Iron Works and Supply Company's Shreveport, Louisiana, meeting are: Front row, C. W. Brown, F. H. Gibson, J. T. Summers, L. A. Ver Bryck, R. L. Brock, M. L. Higginbotham, C. B. Watson, H. L. Reynolds, C. W. Reagor, John F. Pearce, R. D. Poindexter, F. M. Johnson, and Sam W. L. Backus. Middle row, L. Donald, A. B. Harrison, T. C. Poindexter, C. J. Hatcher, H. J. Van Dyke, E. Ball, L. W. Bower, E. V. Riley, L. L. Smith, W. P. Fort, H. C. Guynes, J. T. Shaw, J. T. Miller, T. J. Gibson, and Bill Grabill. Back row, H. A. Adley, B. G. Tatum, Gus Bell, D. W. Deupree, Jr., S. A. Pegues, W. L. Myres, H. F. Brooke, Homer Gray, J. D. McCammon, O. R. Thomas, J. L. Morgan, A. R. Wilson, W. A. Meagher, Ed Mather, J. E. Maricelli, J. O. McMurray, Jr., and H. E. Klapp. The meeting was the annual fall sales meeting.



Easy to Cut Perfect Threads with these RIDGIDs



● The handy threaders that give you smooth perfect threads —extra fast and easy! Quick get-ready—just snap in the size die head you want and start threading. Die heads snap in from either side—can't fall out. Dies are precision-cut of fine tool steel. No special dies needed for close-to-wall work. Ask your supply house for work-saver RIDGID No. OOR, 1/8" to 1"; No. 111R, 1/8" to 1¼"; No. 12R, 1/8" to 2"—free carriers with sets.

RIDGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO. • ELYRIA, OHIO

Dow Assumes Anode Sales

The magnesium sales department, The Dow Chemical Company, has assumed distribution of cathodic protection products from Dowell, Inc., a wholly-owned subsidiary, it was announced by W. S. Loose, sales manager, magnesium department. This change was made to effect closer coordination between research and development, production, and sales of magnesium anodes. Dow will now handle distribution of anodes, Galvoline, and cored magnesium rod.

H. A. Humble

R. L. Featherly

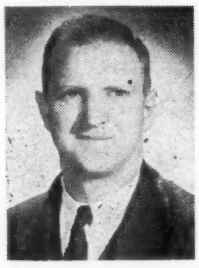
H. A. Humble, manager of Dow's cathodic protection sales, will assume responsibility for the sale of these items. A graduate of Duke University, Humble joined the Ethyl-Dow Chemical Company at Wilmington, North Carolina, in 1933 and continued there until 1946. In 1949, he became manager of Dow's cathodic protection sales. R. L. Featherly will assist Humble in his duties.

Klemp Expansion Set

The William F. Klemp Company has announced completion of a $300,000 expansion program, including the addition of 50 per cent extra floor space at its Chicago, Illinois, plant. In addition to this a new forge welded grating assembly line has been completed. Emerson C. Witney, president, also announced plans for additional expansion in 1952, approximating $500,000.

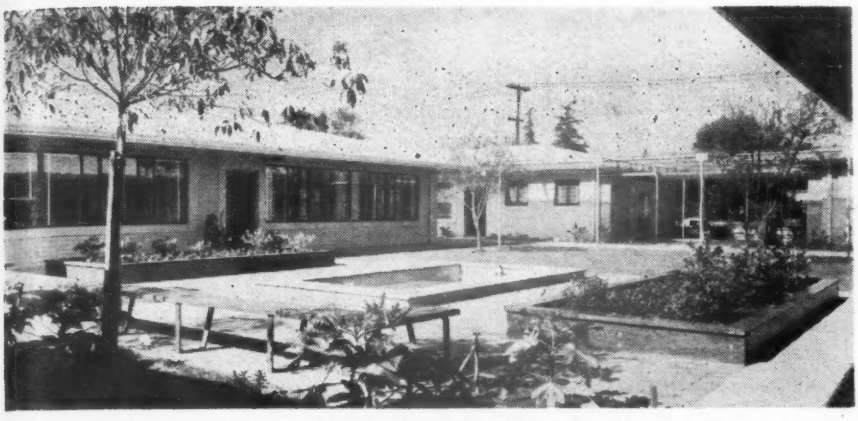
STEPCO Is Organized

The Stuart Steel Protection Corporation (STEPCO) has recently been formed by Linden Stuart as chairman of the board and Linden Stuart, Jr., as president. The offices and warehouse of the corporation are at 2 Mark Road, Kenilworth, New Jersey. STEPCO is eastern distributor of Dowell magnesium anodes. A complete line of cathodic protection supplies and equipment will be carried locally.



Linden Stuart, Jr.

Linden Stuart was associated with the Wailes Dove-Hermiston Corporation (now part of the Koppers Company) for more than 30 years as manager and president. Linden Stuart, Jr., has been with the Barrett division of Allied Chemical and Dye Corporation for several years as eastern sales manager of protective coatings.



Modern, California plant, recently completed by United Geophysical Company at a total cost of $750,000. The new plant houses the five main divisions of the company.

Farrel-Birmingham Buys Consolidated Tool Stock

Farrel-Birmingham Company, Inc., of Ansonia, Connecticut, has acquired the common stock of Consolidated Machine Tool Corporation, Rochester, New York, part of the consideration being securities of Farrel-Birmingham Company. The Consolidated plant will be operated as a subsidiary of the F-B Company and will continue production of its machine tool lines. Arthur H. Ingle will remain as president of Consolidated and will become a director of Farrell-Birmingham Company. Uniting the interests of these two well known firms brings together nearly two centuries of machine and machine tool design and manufacture, Farrel-Birmingham reported.

New Nordberg Office Set Up

Establishment of a Nordberg branch office in Seattle, Washington, has been announced by R. W. Bayerlein, vice president, heavy machinery division, Nordberg Manufacturing Company. In establishing this office, Nordberg acquired the entire sales and service facilities of the former A1-Pac Engine and Equipment Company. Carl S. Harris has been appointed manager of this new West Coast operation.

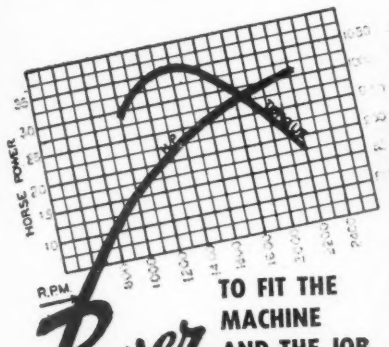
Republic Flow Meters Get New Office Locations

Republic Flow Meters Company, Chicago, Illinois, has opened a factory office in Houston, Texas, to service the expanding industries of the Texas Gulf Coast. George H. (Jack) Woodward has returned to Houston, his former home, as manager of the new office at 2426 West Holcombe Boulevard. He is a mechanical engineering graduate of the University of Texas.

Other recent additions to Republic's field engineering staff include: New factory branch office at 1002 Second Avenue, Seattle, Washington. Henry Weber is district manager of the Washington, Oregon, and Northern Idaho area.

The St. Louis, Missouri, office has been moved to larger quarters at 13 South Meramec Street, Clayton, Missouri, where William G. Baker is in charge. Philadelphia district office has been expanded and moved to 308 Suburban Square Building in Ardmore, Pennsylvania, with Louis C. Walter, district manager.

The Syracuse branch office was recently located at 317 State Tower Building. William J. Angus, district engineer, is a graduate of the Polytechnic Institute of Brooklyn and has had extensive utility and Republic experience. Republic's Buffalo branch office, in the Prudential Building, has lately been placed in charge of Charles T. Duffy.



Power TO FIT THE MACHINE AND THE JOB

WISCONSIN-POWERED
Rotary Drilling Rig Generator

Another camera-eye report about a vital oil field task! This 2-cylinder Wisconsin Heavy-Duty Air-Cooled Engine powers the generator of a rotary drilling rig at an Oklahoma field.

Wisconsin Engines stand up under the toughest demands of oil field power service. And *unbeatable* power of this kind results from such *unbeatable* features as tapered roller bearings at both ends of the crankshaft as protection against bearing failure, *plus* fool-proof, any-weather AIR-COOLING. Combine these with an easily-serviced OUTSIDE magneto with impulse coupling for any-weather starts and steady running . . . and you have the inside story *behind* the *far ahead* performance of Wisconsin-powered equipment.

4-cycle single-cylinder, 2-cylinder and V-type 4-cylinder models, 3 to to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

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M & M BUILDING, HOUSTON, TEXAS
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OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.

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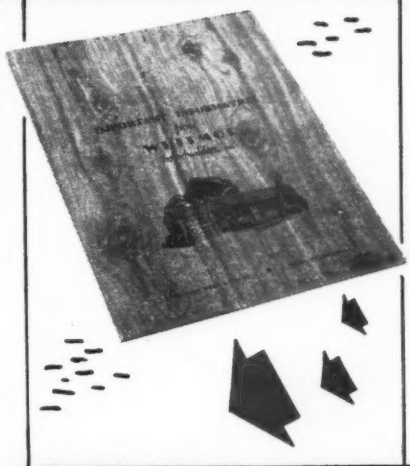
IMPORTANT INFORMATION
ABOUT FIELD HOUSING



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NAME.....
COMPANY.....
ADDRESS.....
CITY..... ZONE.....
STATE.....

Rust-Oleum sales organization met recently to outline sales plans for 1952.

Rust-Oleum Sales Group Meet at Evanston, Illinois

Highlighting the three-day meeting of the Rust-Oleum sales organization, held at the main plant of the Rust-Oleum Corporation, Evanston, Illinois, recently were the 1952 sales plans outlined by Robert Fergusson, company president. In addition to the 1952 plans, the three-day meeting included a tour through the new plant facilities. Attending the meeting were: First row, John Winter, Albert Ahlff, A. H. "Mike" Empson, Otis B. Casanova, J. Olin Jones, Sr., Arnold Hoffmeyer, H. Wallace Edwards, Ted White, Warren Risk, U. Stanley Ackles.

Second row, Paul Moffit, Donald Fergusson (vice president), L. J. Rumig, R. J. Zobel, Phil Webb, James Boren, Lee Hill, Earl Lyons, J. H. Moran.

Third row, Harry Barth, Erwin Randt, Charles McGee, J. R. Baker, Paul Harkonen, advertising agency—O'Grady-Anderson-Gray, Inc.; J. A. Larson, Walter Fenn, T. R. Mumford, J. H. Lund, J. E. Merritt.

Fourth row, R. D. Repass, William O'Grady, advertising agency; W. A. Bellows, Thos. F. O'Malley, W. D. Home, Robert Gray, advertising agency; J. C. Simmons, C. N. Johnson, Rust-Oleum superintendent of manufcaturing, Jack Copeland, Dale W. Kimmel, and W. K. Ingalls.

Standing, Robert A. Fergusson, president.

Peerless Pump Sales Meet

District sales managers and certain engineering and administrative personnel of Peerless Pump Division, Food Machinery and Chemical Corporation, met in New Orleans, Louisiana, recently. The meeting was directed by G. F. Twist, FMC vice president and Peerless divisional general manager with B. A. Tucker, Peerless divisional sales manager, chairman.

In the group picture are personnel that attended the meeting: First row, C. L. Nickel, W. E. Griffin, C. C. Cook, E. W. Lundy, J. C. Bonsall, C. H. Sortor, E. H. Lanthorn, F. W. McCann, S. M. Riordan, and R. H. Hull.

Back row, G. F. Twist, B. A. Tucker, E. H. Hansen, and D. R. Rankin.

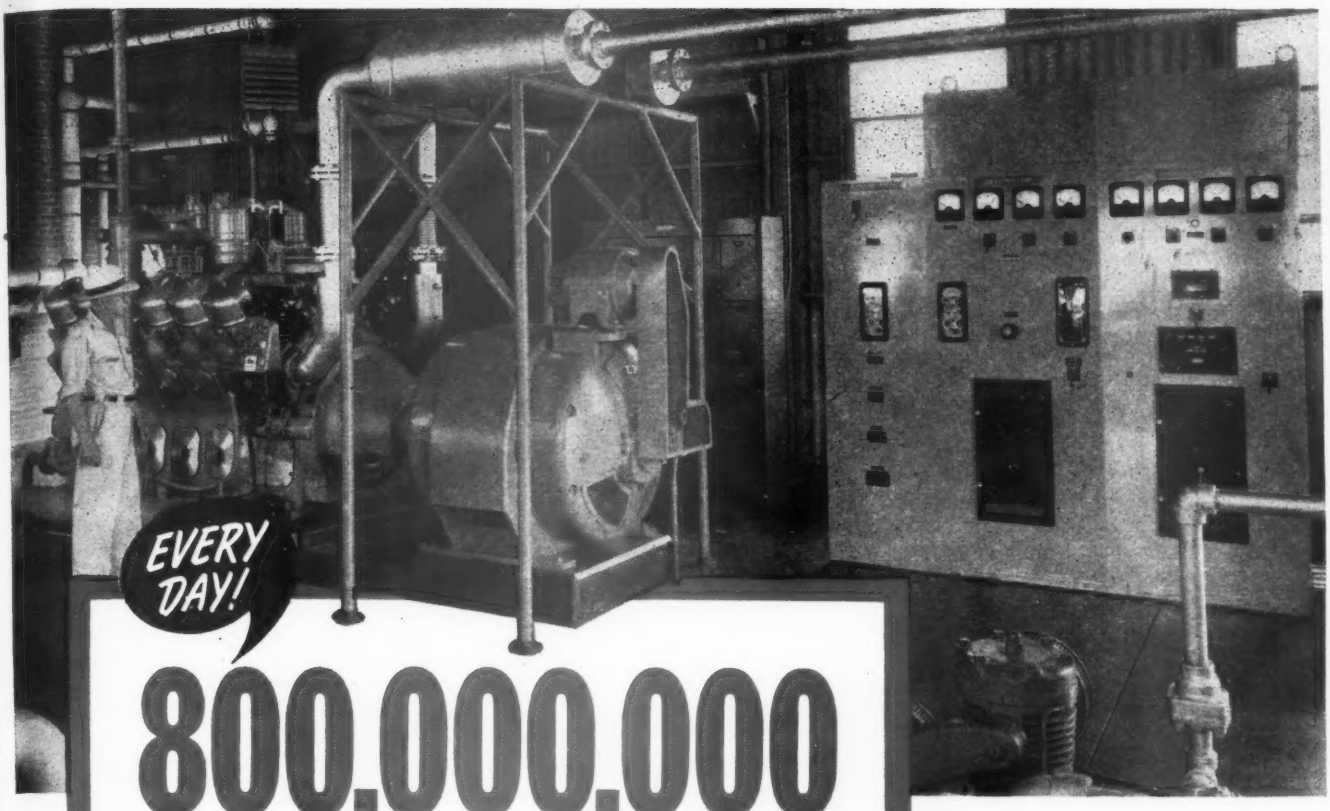
Sharples Chemicals Combines With Pennsalt

The combination of Sharples Chemicals, Inc., with the Pennsylvania Salt Manufacturing Company through an exchange of common stock has now been effected, George B. Beitzel, Pennsalt president, announced. For the present, Beitzel said, Sharples will continue to operate as a separate unit of Pennsalt, with, however, an exchange of technical information.

Forms New Department

Chemical plants division of Blaw-Knox Company has organized a research and development department and appointed Dr. H. B. Coats as its director, it was announced by E. W. Forker, head of the division. Among the functions of the new department will be the study and evaluation of new processes. "Special attention will be given," Forker said, "to development of industrial applications of atomic energy." Coats received his doctorate in chemical engineering at the University of Michigan.

Peerless Pump Division district sales managers in New Orleans meeting. G. F. Twist directed the meeting.

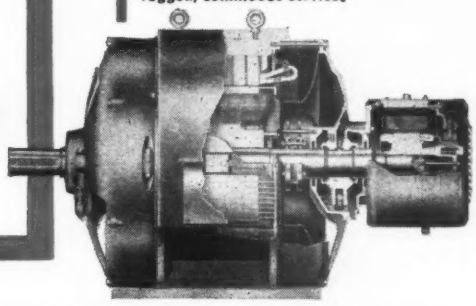


EVERY DAY!

800,000,000 CU. FT. OF GAS

SAFEGUARDED BY *Standby* POWER UNITS

Below is a cutaway view of an E-M Synchronous Generator. A heavy duty type, it features a direct-connected exciter. Designed for top efficiency in rugged, continuous service.



E-M Synchronous Generators ready for emergency action at Texas Eastern gas pipe line stations

With a tremendous daily gas pipe line volume such as this, *protection equipment* can be just as vital as production equipment. Planning ahead to meet any power emergency, Texas Eastern Transmission Corporation has equipped its compressor stations with standby power units.

Essential part of the unit at the Lebanon, Ohio reciprocating station (above) is a 375 kva, 1200 rpm E-M Synchronous Generator.

If high line power should fail at this station, the E-M Generator immediately supplies emergency power to operate the station. When main power is restored, the Generator synchronizes with the central power line and a relay drops off the standby unit. It is ready again for instant service whenever needed.

How much is this emergency power worth to you? In most cases, cost of the standby unit is only a fraction of the losses which might be caused by a major system breakdown. E-M's widely-used High-Speed Synchronous Generators, ranging from 1.25 to 5000 kva, are designed and built for consistent, dependable service under a variety of operating conditions.

Call your nearest E-M sales engineer for his recommendation on your requirements. Or write and ask the factory for *E-M Synchronizer* No. 35.

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

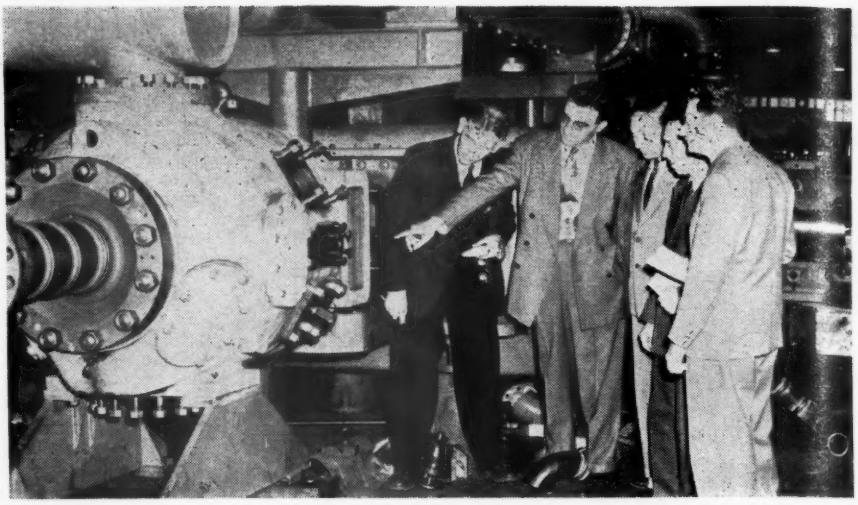
Specialists in

DEPENDABLE POWER APPARATUS

2100-TPA-2109

European Oil Men Tour Worthington Pump Plant

Ten petroleum experts from five free nations of Europe were conducted through the Buffalo, New York, plant of Worthington Pump and Machinery Corporation recently. This was one stop for these refinery managers, engineers, and equipment manufacturers in a six-week tour of American plants. Known as "Operation Impact," the tour is being conducted to demonstrate modern American equipment and methods. It is sponsored by the Economic Cooperation Administration under its technical assistance program. The study was requested by the Organization for European Economic Cooperation (OEEC) representing the Marshall Plan countries, whose mounting defense needs for oil products have been made more critical by the shut-down of the Iranian source of supply to these countries.



James J. Julian shows air compressor to Giorgio Millo, Italy; Edgard F. G. Demierbe, Belgium; Louis Schoorl and Eduard W. Insinger, Holland.

Tulsa Equipment Company's new headquarters.

Tulsa Equipment Sees Seventh Year in Business

Tulsa Equipment Company, Inc., completed its first year in its new and expanded headquarters in December, and its seventh in existence. Founded in 1944 by F. L. Squires, president of the firm, the company is now in its third location. Vice president is C. L. (Shorty) Edwards, with Bill Fuller, salesman and secretary-treasurer as the third officer.

The company serves major oil, pipe line companies, highway, and bridge contractors in the Tulsa area, enjoying a high percentage of repeat business.

Insul-Mastic Holds Forum

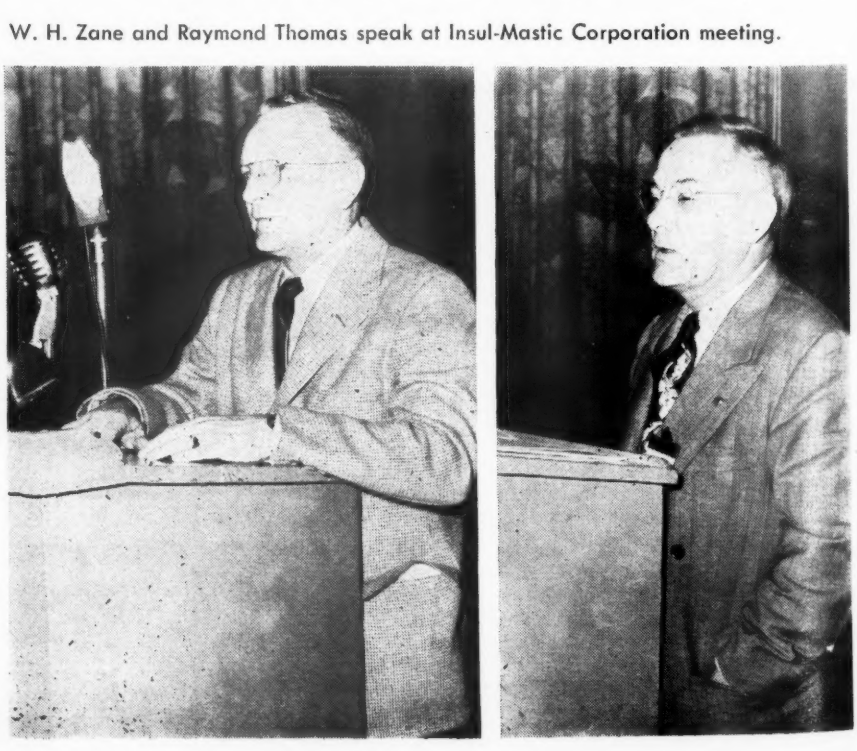
The Insul-Mastic Corporation of America, makers of heavy protective coatings, held its annual sales and technical forum for the company's licensees in New Orleans, Louisiana, recently. The convention took place at the Jung Hotel. The three-day meeting featured speakers holding important engineering positions in well known companies.

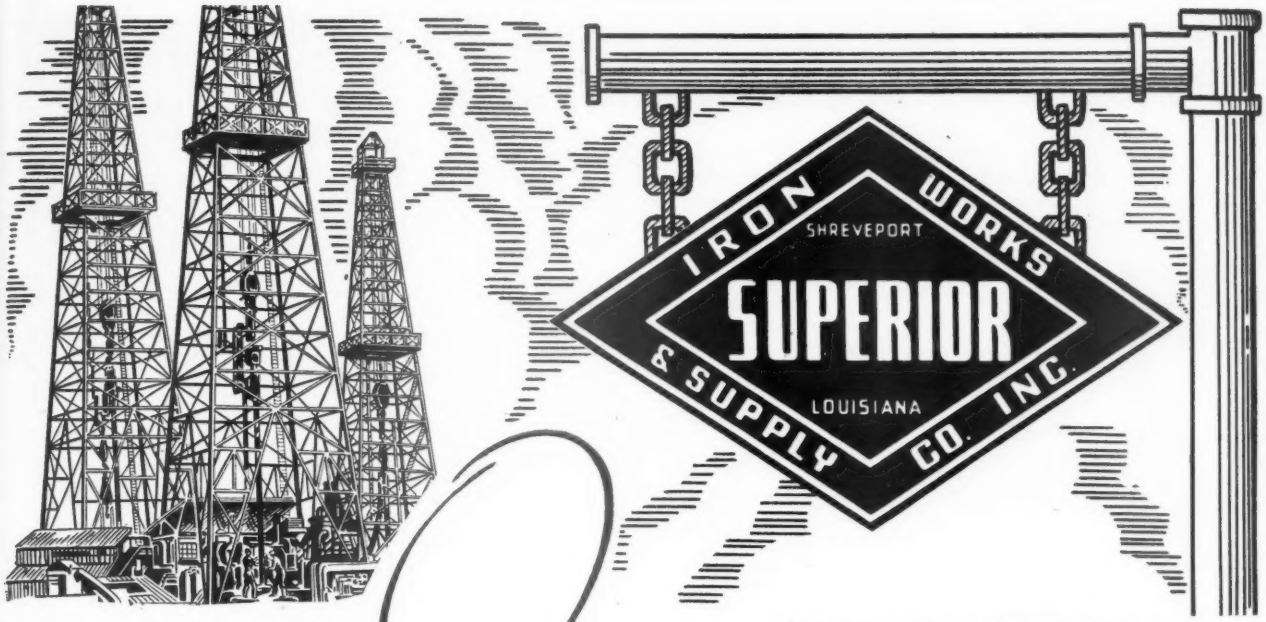
Leading off the technical side of the program was Professor Elmer R. Queer of Pennsylvania State College. He spoke on the "Effect of the Transmission of Moisture Vapor on Protective Coatings, Building Construction and Insulation." W. H. Zane, chief insulation engineer of E. I. du Pont de Nemours and Company, told how du Pont uses protective coatings to keep insulation dry. The problems of preventing corrosion in steel mills were unfolded by Herbert L. Coe, superintendent of maintenance at the Clairton works of the United States Steel Company. Coe particularly dwelt on the situation in coke by-products areas where acid laden steam from quenched coke causes considerable corrosion.

Frank R. Jelinek, chief engineer of the Neches-Butane Products Company told of his company's expensive experience with corrosion caused by water-soaked insulation on its fractionation towers.

Raymond Thomas, staff engineer of the Union Carbide and Carbon Corporation closed the convention with his talk on the application of water repellent coatings to thermal insulation.

W. H. Zane and Raymond Thomas speak at Insul-Mastic Corporation meeting.





FROM *One* PIONEER TO *Another* . . .

When those pioneers in major oil field development first tapped the vast East Texas underground stores in 1930, they knew even then they could call *Superior* for fast, dependable service.

Yes, Superior was on hand in 1930 as in 1951—pioneering to bring the oil, gas, and pipeline industries the best in equipment. No matter *what* your operation—drilling, production, pipelining, or refining—Superior can give you top-notch supplies and technical advice in a hurry. No matter *where* your operation—there's a Superior store in calling distance to fill your order immediately.

Save time and money—call your *Superior* store!

13 CONVENIENT STORES AND OFFICES TO SERVE YOU

- Shreveport, Louisiana
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SUPERIOR IRON WORKS & SUPPLY COMPANY, INC.

1202-04 MARSHALL STREET • P. O. BOX 1800 • SHREVEPORT, LA.

TRADE PERSONALS

M. J. Harper has been named head of the Eastern region of Rockwell Manufacturing Company, with headquarters

J. W. Northcutt

M. J. Harper

in New York City. The appointment came as a result of a country-wide reorganization of the company's sales department. Other new managers were appointed as follows: **C. K. Madison**, Mid-Western region, Houston, Texas; **J. W. Northcutt**, head of the southern region, with offices in Atlanta, Georgia; **P. C. Kreuch**, head of the central region, with headquarters in Pittsburgh, and **H. Boezinger**, head of the western region, with offices in Los Angeles, California.

C. K. Madison

Harold Shalit has joined the research division of Houdry Process Corporation. Receiving his Ph.D. at Polytechnic Institute of Brooklyn, he was associated with the research department of Standard Oil Company of Indiana before joining Houdry. Another new member of Houdry's research staff is **L. Edward Godycki**, who recently received his Ph.D. from Iowa State.

Howard L. Richards has been named as director of industrial relations for Baash-Ross Tool Company's nation-wide manufacturing and operating locations. Richards brings to his new post more than 12 years experience in the field of industrial relations, during which time he has handled labor relations with various companies. Richards attended the University of Nebraska specializing in the field of business administration, subsequently took additional studies at the University of Southern California and the University of California at Los Angeles in labor relations and industrial management, preparatory to his present work.

H. L. Richards

M. Nielsen has been elected as an assistant vice president of the The Babcock and Wilcox Company. He will report directly to C. H. Gay, vice president in charge of manufacturing, and will assist him in the operations of all of the company's plants in the boiler division. Nielsen's headquarters will be at Barberton, Ohio. Nielsen joined Babcock and Wilcox in 1924 in the erection department at Chicago. From 1927 to 1936 he was district inspector of erection in the Chicago district and was in charge of erection in the Cincinnati district from 1936 to 1938. In 1950 he was made an executive assistant and placed in charge of the contract division, with headquarters in New York.

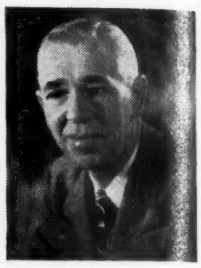
Norman E. Carlson has been appointed assistant chief mechanical engineer of the American Car and Foundry Company. Coming to ACF after eight years' service with the Great Northern Railway, he will make his headquarters in New York. Carlson was born in South St. Paul, Minnesota, in 1911. He was graduated from the University of Minnesota in 1933. From then until 1939, he served in automotive engineering work with Swift and Company in South St. Paul and Chicago.

Harry J. Lemmer has been appointed advertising manager of the Waukesha Motor Company. Lemmer entered the Waukesha Motor organization in 1942, following a number of years as Chicago passenger traffic representative for the Union Pacific Railroad and service in the passenger and promotion departments of the Illinois Central and Chicago Great Western Railroads. During the war Lemmer acted as Technical Information Manager and supervised the publication of technical manuals ordered by the Armed Services. In 1946 he assumed the duties of assistant advertising manager and served in that capacity for five years. He has been active in community and charitable enterprises in Waukesha.

H. J. Lemmer

G. B. Strausner, Pittsburgh district sales manager for The Youngstown Sheet and Tube Company, retired recently after 40 years of service with the company. **A. A. Hare**, who has been assistant district sales manager in the Pittsburgh office since April 16, 1945, succeeds Strausner as district manager. L. E. Wallace, general manager of sales, announced.

F. S. Ward



A. J. Fleig

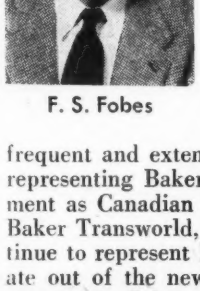
Frank S. Ward has been named as general sales manager of Taylor Instrument Companies, succeeding Raymond E. Olson, newly elected president. Ward joined the company in 1917, and since 1945 has been industrial sales manager. He is succeeded by **Albert J. Fleig,** who since 1945, has been divisional sales manager in charge of sales to the chemical, petroleum, and canning industries. He joined the company in 1919.

George E. Heller has been made manager of a new industrial sales division handling products sold to the chemical industry. Heller joined the firm in 1935, and last March became associated with the Industrial sales department. **Richard N. Pond** has been named divisional sales manager handling the sale of industrial instrumentation to the petroleum and canning industries. Pond joined the company in 1941.

F. J. Solon, Jr., was elected vice president-advertising and public relations of Glass Fibers, Inc., recently. Before joining Glass Fibers in 1947, Solon had been western general manager for the advertised drug division of American Home Products Corporation, previous to that in the radio broadcasting industry. He is a University of Notre Dame graduate.

Raymond W. Capaul was elected vice president and general sales manager. He joined Glass Fibers in 1948 as electrical division manager and was promoted to general sales manager in July 1949. He is an engineering graduate of the University of Toledo.

F. S. "Bud" Fobes has been transferred by Baker Oil Tools, Inc., and Baker Transworld, Inc., from California to Calgary, Alberta, Canada. He will assume the duties of division manager of Baker Transworld's newly established Canadian division. His previous assignment as assistant sales and service manager of Baker Oil Tools' western division included frequent and extended visits to Canada representing Baker. In his new assignment as Canadian Division Manager of Baker Transworld, Inc., Fobes will continue to represent Baker, but will operate out of the newly established headquarters in Calgary which will facilitate Baker's Canadian operations.



F. S. Fobes

Elwyn Mercer, industrial manager of the southwestern territory since 1947, left recently for England, to become general manager of Allis-Chalmers tractor division operations in that country. Mercer is well known in A-C circles. He attended the University of Idaho, graduating in 1936 with a masters degree in mechanical engineering. He has been with the company ever since, except during World War II when he was on leave of absence to the War Production Board in Washington, D. C., which was followed by a tour of Navy duty in the Pacific.

Elwyn Mercer

N. T. Joyner, a prominent figure in the glyceride oil field, has been appointed to an important post on the technical staff of the votator division of The Girdler Corporation. Joyner was born in Columbia, South Carolina, and received his B. S. degree in chemistry at the Virginia Military Institute. In 1929 he became associated with the Buckeye Cotton Oil Company, a subsidiary of Proctor and Gamble Company, and later transferred his activities to the parent company. He was assistant director of research for Lever Brothers Company.

Fred A. Koch has been named special assistant to Donald K. Ballman, general sales manager, Dow Chemical Company. With the establishment of two new Dow international subsidiaries, **Clayton S. Shoemaker,** Dow's former eastern sales manager had resigned his post to head up the new organizations, and the positions of eastern sales manager and assistant eastern sales manager have been discontinued. Koch had held the latter position for the past eight years and has been associated with Dow since 1919.

Harry E. Estes has been appointed to fill the newly-created position of assistant to the president of A-1 Bit and Tool Company. He brings to his new position a background of 23 years experience in oil field equipment manufacturing, being associated in various capacities with Gulf Refining Company, Houston Foundry and Machine Company, and Reed Roller Bit Company. For the past 5 years, he has served as purchasing agent and director of public relations for A-1 Bit and Tool. Estes is local executive secretary of the Houston Chapter of Nomads, as well as national executive secretary for that organization. **Ray Osborn** will succeed Estes as purchasing agent.

H. E. Estes

Carlton H. Gilbert has been appointed to the newly-created position of advertising manager, United States Rubber Company, effective February 15. Gilbert began his advertising career in 1927 with J. C. Bull, Inc., New York advertising agency. He continued there until 1934 when he joined the sales promotion department of United States Rubber Company's footwear division. In 1939 he was appointed sales promotion manager of the division and later he assumed the additional title of advertising manager of the division. He was graduated from Dartmouth College in 1927, after which he took a post graduate course in advertising at New York University.

Lyman D. Warner has been appointed to the position of vice president in charge of market and product development and promotion for the American District Steam Company, Inc., North Tonawanda, New York. Warner will be responsible for the planning and execution of programs that will lead the company into the development and sales of new and related products, as well as the wider application and sale of existing lines. In addition, he will continue in charge of all sales activities relating to defense production.

L. D. Warner

Dahl E. Brewer of United Centrifugal Pumps has been appointed in charge of sales throughout Northern California and Utah. He has served in various capacities for the Oakland, California, manufacturing concern over a period of several years. Brewer is widely known throughout the petroleum and other industries, having specialized for the past 15 years in engineering and sales of centrifugal pumps.

D. E. Brewer

R. G. Cole has been promoted to sales manager of the Orbit Valve Company, Tulsa, Oklahoma. Cole has recently been Gulf Coast district manager for Orbit Valve Company, at Houston, Texas. He has been associated with the company since 1941. Cole will immediately move to the Tulsa office. Other changes announced by Orbit Valve are the appointment of **L. E. "Ed" Wallace,** formerly a field salesman for Orbit, as Gulf Coast district manager in Houston; and the inclusion of Dallas and Fort Worth in the territory of **Peter P. Kizis,** field representative for Orbit in the North Texas area. Kizis now headquarters at Wichita Falls, Texas.

Dr. Lauriston C. Marshall has been appointed director of Link-Belt Company's new physical testing and research laboratory at Indianapolis. As director of the new laboratory, Dr. Marshall will be responsible for an extensive program of original research, as well as for continuing investigation into ways and means of improving production methods and the quality of conveyor and power transmission products developed by Link-Belt's 16 manufacturing plants in the United States, Canada, and South Africa. Dr. Marshall has been professor of electrical engineering at the University of California (Berkeley).

Dr. L. C. Marshall

Herman B. Robbins has been named as sales manager of the generator set division of John Reiner and Company, Long Island City, New York. The generator set division handles the distribution and sales of D. W. Onan generator sets as well as the John Reiner and Company line of diesel and gasoline generator sets, marine auxiliaries and oil field utility units. In addition to his regular duties, Robbins will also be in charge of all the export activities of the company.

D. R. Cumming has been promoted from sales manager to division manager of Oil Well Supply Company's export division, a U. S. Steel subsidiary. Export division headquarters are situated at New York City. Cumming succeeds **M. E. Keenan,** who retired after more than 30 years service. A native of Cordele, Georgia, Cumming attended the U. S. Naval Academy at Annapolis and spent three years with Lago Petroleum Corporation in Venezuela before joining "Oilwell" in 1937.

Delbert D. Lewis of Import Tool Company Ltd., of Edmonton, Alberta, Canada, has been appointed Canadian representative for Thornhill - Craver Company of Houston, Texas. Lewis is well known throughout the United States, Canada, and South America. He served as drilling superintendent for Standard Oil in Venezuela for a number of years and was field superintendent for Newell and Chandler in the Turner Valley field in Alberta, Canada. While under contract for Creole Petroleum in Venezuela, he drilled the deepest hole in South America—and the fourth deepest in the world—at 17,040 ft. Lewis' head office is at Edmonton and warehouses are at Calgary and Stettler.

D. D. Lewis

ARMSTRONG BROS.
Better PIPE TOOLS

PIPE CUTTERS

"ARMSTRONG BROS." Three wheel and Standard wheel and roller Pipe Cutters are quality cutters throughout . . . built to give years of good service.

"ARMSTRONG BROS." drop forged Pipe Cutters are built for lifetime service with one-piece drop forged steel heat treated body and a replaceable hardened steel nut to take up the wear and thrust of handle screw. Used either as 1-wheel (with 2 rollers) or 3-wheel (for close quarters).

"ARMSTRONG BROS." Knife Blade Cutter Wheels are machined from special alloy tool steel properly heat treated. They cut rapidly and easily, hold their keen edge.

Write for Catalog

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5231 W. ARMSTRONG AVENUE • CHICAGO 30, ILL.

Business and Pleasure in TULSA means-

THE MAYO

★ CENTRALLY LOCATED
★ AIR CONDITIONED
★ COFFEE SHOP

Mac H. Hull, assistant to vice president, Universal Atlas Cement Company, has been appointed assistant vice president, and **James C. McClure,** was named sales manager of the company's Dayton, Ohio, territory, both with offices in New York City. Effective the same date, assistant sales manager at Dayton, **David H. Deacon,** was named sales manager, succeeding McClure.

Hull attended Howard College, in Birmingham, Alabama. He has been associated with the cement company for 31 years, having joined the company as correspondent at Birmingham in 1921. In 1946 he was advanced to the post of assistant to vice president, general sales, New York.

McClure, a civil engineering graduate of Ohio State University, joined the cement company in 1927. In 1938, he was appointed district sales manager at Albany, New York, and in 1946, sales manager at Dayton.

Deacon attended New York University and the American Institute of Banking. He was associated with the securities division of First Boston Corporation for 10 years before joining Universal Atlas Cement in 1941.

H. G. ("Beans") Rice has been named sales and service representative for Web Wilson Oil Tools in Venezuela and Colombia for Web Wilson Oil Tools, Inc., and their export representatives, R. J. Eiche and Associates, of New York and Los Angeles. Headquarters for Rice will be at Maracaibo. Rice is a graduate of Texas A. and M., with a degree in petroleum engineering. He has had wide experience in drilling, production, and materials procedure while employed by Shell Oil Company as petroleum engineer and materials supervisor in Both Mexico and Colombia.

H. G. Rice

L. J. Carson, former general manager of Link-Belt Company's Minneapolis plant, has resigned from his position as price executive of machinery branch of the industrial materials and manufactured goods division of OPS, in Washington, D. C., and has been named general manager of Link-Belt's new Colmar, Pennsylvania, plant. This plant is now under construction and is scheduled to be in operation during the last quarter of 1952. Carson is an engineering graduate of the University of Pennsylvania, 1927. He began his career with Link-Belt in the engineering department of the San Francisco plant in 1935.

C. J. O'Neil has been appointed to the newly created post of merchandising manager for the Johns-Manville celite (diatomaceous silica) division. O'Neil's new post was created to extend distribution of the company's celite fillers and filter aids produced at the company's diatomite mine and plant in Lompoc, California, so as to fill shortages created by unusually heavy industrial requirements. He joined Johns-Manville in November, 1928, as a sales engineer for the celite division in New York City.

He was graduated from the Worcester Polytechnic Institute.

Roy H. Langford has joined the Iverson Supply Company, Tulsa, as machinery representative and will be stationed at Iverson's general offices at 400 West Fifth Street in Tulsa, Oklahoma. Langford attended Tulsa University, prior to his serving in the United States Air Force for five years. Upon returning to civilian life he joined Ideco's supply store division, serving in various capacities including that of district manager of Oklahoma.

R. H. Langford

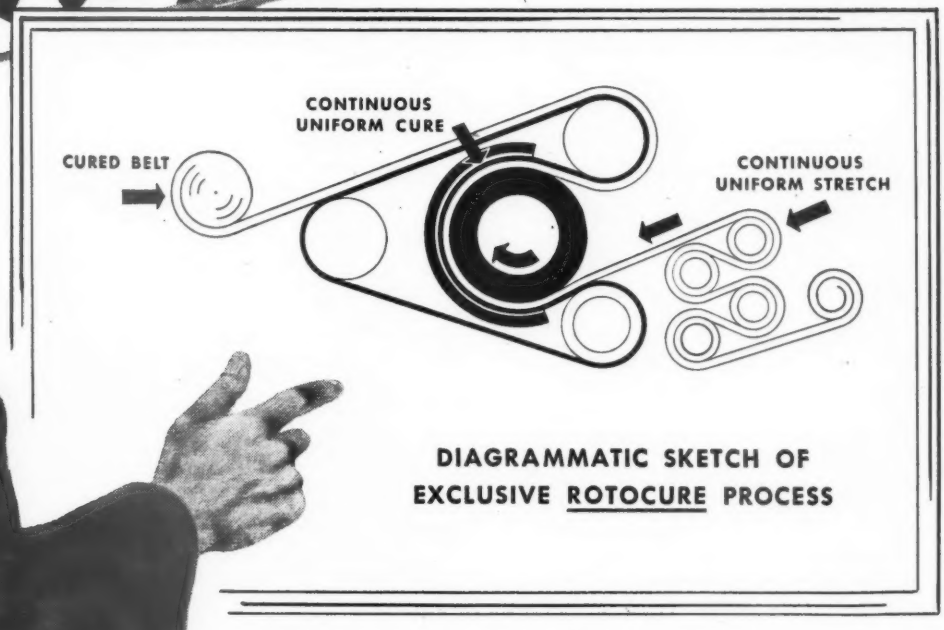
Nelson S. Cobleigh has been named district manager of the Ampco Metal, Inc., Philadelphia sales division. He was formerly a field engineer in the Wisconsin office, and later was transferred to the Detroit district office where he served as field engineer for 2½ years prior to this recent appointment.

B. E. "Ben" Mater, export sales engineer for Baker Oil Tools, Inc., has just returned from his second trip this year to Venezuela, where he has spent the past few months consulting with operators and assisting in the operations of Baker's subsidiary company, Baker Transworld, Inc. Mater reports that more strings are working in both Eastern and Western Venezuela than at any time in the past and that the tendency is apparently toward even further increase. Production is at a peak and the new discovery fields in Western Venezuela, with their lighter oil, seem to offer a potential increase in both quality and quantity of production.

W. Edward Largey has been appointed general salesmanager of Petroleum Engineering Associates, Inc., and Oil Properties Consultants, Inc., Pasadena, California. Petroleum Engineering pioneered reservoir engineering and laboratory service. Oil Properties Consultants, Inc., specialize in geological and engineering service. Largey long a prominent figure in petroleum circles, formerly was advertising director of Byron Jackson Company and Emsco Derrick and Equipment Company.

W. E. Largey

Keep 'em Moving



DIAGRAMMATIC SKETCH OF
EXCLUSIVE ROTOCURE PROCESS

—that's how ROTOCURE prevents OCS*—Achilles Heel of Conventional Belts!

"Start and stop" vulcanization (the conventional flat press method) can bump conveyor belt costs way out of line due to short life and constant replacements. Here's why: Press overlaps are *unavoidable* in this method of belt manufacture. They *result in overcured segments that weaken the belt.*

Why Rotocure-made Belts Are Superior to Flat Press

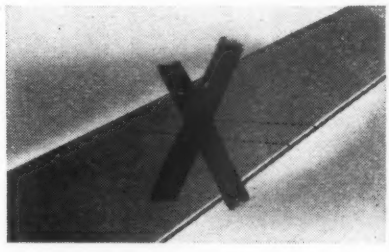
The BWH—pioneered method of ROTOCURE is a continuous, endless curing process of uniform belt advancement. Every inch of the belt is subjected to *identical* curing—in amount and in time. Thus weak segments due to overlapping are eliminated automatically by the process itself.

Why Rotocured Belts Should be on Your Jobs

The weak segments you *don't get* in BWH conveyor belts mean you *do get:*

1. Increased belt flex life—up to 40%.
2. Elimination of mechanical distortion at the press ends.
3. Constant, uniform stretch.
4. Uniform, abrasion-resistant covers.

For years, it's been an established fact among users that BWH Rotocured belts are "tonnage producers." If *you* want longer belt life, a good size dip in belt maintenance costs and savings per ton in materials conveyed ask your BWH distributor. He *knows* who's buying the values! Or write us direct.



*Overcured Sections-present every 30′ to 40′ in all belts made by the flat press method. Only Rotocuring (continuous, non-stop curing) eliminates this major cause of belt failures.

BWH
DEPENDABLE RUGGEDNESS

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Warehouse Stock: 111 N. Canal St., Chicago, Illinois **Distributors in all Principal Cities**

PLANT: CAMBRIDGE, MASS. • P. O. BOX 1071, BOSTON 3, MASS., U. S. A.

Russell H. Coe has been appointed to represent The Tapecoat Company, Evanston, Illinois, on its coal tar tape for pipe joint protection, in Ohio, West Virginia, and western Pennsylvania. Coe has had broad experience in the pipe protection field. He was formerly with Pittsburgh Coke and Chemical Company, in charge of coatings, and also was associated with Pipe Line Service Corporation.

R. H. Coe

John M. Otter, formerly vice president and general sales manager, Philco Corporation, was appointed vice president and general manager of the refrigeration division, and will head the management of all Philco appliances, including electric ranges and room air conditioners. Since joining Philco in 1926, Otter has achieved a series of successes in various sales capacities.

Thomas A. Kennally, former president of the refrigeration division, will become vice president on the executive staff and chairman of the distribution committee. He has been with the company 27 years.

Raymond B. George, who joined Philco in 1936 and was named in 1950 vice president-merchandising of the television and radio division, has been appointed corporate vice president of merchandising.

Frederick D. Ogilby has been named vice president television and radio division in which capacity he will direct all sales activities of the division as well as all product development of the line. Ogilby, manager of television sales prior to his appointment as a vice president in 1949, joined Philco in 1931 as a sales representative in the New York division of Philco Distributors, Inc.

John Kuneau, while retaining his post as vice president on the executive staff in charge of public relations for Philco Corporation, will also serve as chairman of the newly formed merchandising committee for television and radio activities reporting directly to Larry F. Hardy, president of the division. Kuneau joined Philco in 1950.

John L. Utz, in field sales for 14 years as a district representative and division manager, has been advanced to national sales manager of television. **John J. Moran** will continue as Philco's national sales manager of radio.

Dr. Ambrose G. Whitney has joined The Davison Chemical Corporation's Research and Development Department as a development engineer. He was formerly with Armour and Company in Chicago. He was a graduate in chemistry of the College of St. Thomas, St. Paul, Minnesota, in 1936 and received his Ph.D. degree from the University of Minnesota in 1940.

Pierce J. Fleming, manager of Mack Motor Truck Corporation's off-highway sales division, has been elected a vice president of the company. A pioneer in the truck sales field, Fleming joined Mack in 1918 and had served as Mack district manager in Buffalo and Cincinnati before becoming district manager at St. Paul in 1938. He was transferred from that position in 1949 to take up his present duties.

P. J. Fleming

Malcolm P. Murdock, manager of the central sales region of Ethyl Corporation, has been promoted to general sales manager. He will coordinate and direct the sale of antiknock compounds and a growing list of special purpose chemicals. Although his headquarters have been in Chicago for the past year, he has transferred to the New York office.

Murdock attended Cornell University, where he was graduated in 1928 with a B.A. degree. He joined Ethyl Corporation in 1933 as a field representative. In 1947 he was appointed assistant general sales manager of the Corporation, a position he held until September 1950, when he became manager of the central sales region. **S. T. Pruitt,** assistant manager, will succeed Murdock.

A.P.I. PIPE COUPLINGS

All Sizes and Types for Oil Field Use

LINE PIPE COUPLINGS A.P.I.
⅛" to 12"—Seamless and Special Processed—Black or Galvanized

PLAIN TUBING COUPLINGS A.P.I.
1" to 3"—Seamless

EXTERNAL UPSET TUBING COUPLINGS A.P.I.
¾" to 3½"—Seamless

CASING COUPLINGS A.P.I.
4½" to 13⅜"—Long or Short

HYDRAULIC COUPLINGS
⅛" to 3"—Seamless

REAMED AND DRIFTED A.I.S.I.
¾" to 12"—Seamless or Spl. Processed

DRIVE PIPE COUPLINGS
⅜" to 12"—Seamless or Spl. Processed

Consult Our Nearest Quick Service Sales Office:

Albany, N. Y.—Albert L. Becker, 434 Clinton Ave.
Baltimore—Ted Barto, 2301 N. Charles St.
Boston—Wm. F. Bennett, 24 Spring St., Somerville
Buffalo—W. E. Spencer & Assoc's, 241 S. Elmwood Ave.
Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
Houston—Henry H. Paris Distributor, Inc., Bo 932
Kansas City, Mo.—Wm. J. Hebenstreit, 3122 Coleman Rd.
Los Angeles—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis—Lin J. Krause, 200 Lumber Exchange
Newark, N.J.—Murray Eskin, Industrial Office Bldg.
New York—Henry Stein, 50 Cliff St.
Philadelphia—J. W. Worthington, 401 N. Broad St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., Mutual Bldg.
San Francisco—Earl H. Jones & Co., 1150 Folsom St.
Seattle—Earl H. Jones & Co., 619 Second Ave.

FACTORY 'PHONE: WOODSDALE 3296

WHEELING MACHINE PRODUCTS COMPANY

ELM GROVE STATION — WHEELING, W. VA.

J. Henry Anthony, manager of the industrial engineering division, has been appointed plant superintendent of Whitney Chain Company in addition to his existing duties. Anthony has been associated with Whitney Chain Company in various factory production capacities for the last 12 years. Prior to joining Whitney Chain in 1940, he was in charge of the manufacturing division of Manning, Maxwell and Moore, of Bridgeport, Connecticut, producers of valves and industrial gages.

J. H. Anthony

Charles R. Becker, formerly sales manager at Cambridge, Massachusetts, for J. W. Greer Company is moving to the West Coast to open and manage the western sales office in San Francisco. This new office will concentrate on the growing markets of the 13 westernmost states, Mexico, and Western Canada. **Walter Salter,** who has been representing the Greer Company in the southeastern states, is moving to manage the office at 475 Fifth Avenue, New York City. This office will be sales headquarters for 24 eastern and southern states. He succeeds **Melvyn Mickevic,** who has resigned to work in another industrial field. **Rod Grace,** formerly representative covering New England and Canadian territories, has been moved to become acting sales manager in the Cambridge sales office.

Clayton F. Ruebensaal, formerly technical director, plastics, and resins for Naugatuck Chemical division, United States Rubber Company, has been named to the newly-created position of commercial development manager. **Dr. D. Lorin Schoene,** formerly manager of organic research, was named to succeed Ruebensaal as manager of plastics development. In his new position, Ruebensaal will concentrate on developing new commercial outlets for the products of Naugatuck's fundamental research. His work will include the economic evaluation of raw material supplies, plant sites, potential markets, competition, etc.

A Ph.D. in chemistry from Iowa State College, Dr. Schoene joined U. S. Rubber in 1939 as a chemist.

George H. Reiter, vice president and general sales manager of Universal Atlas Cement Company, has been named to the newly created office of executive vice president. **Fred T. Wiggins,** vice president and assistant general sales manager, has been named vice president and general sales manager; **Charles B. Baker,** assistant to president and secretary, has been named vice president and general attorney; **Donald C. Leo** has been named secretary, and **Edward D. Depew,** attorney, has been named assistant secretary of Universal Atlas Cement.

J. C. "Jack" Miller has been appointed by United Centrifugal Pumps as regional sales manager for the Mid-Continent area, according to an announcement issued by the firm's Oakland, California, offices. For the past 17 years, Miller has been closely associated with the petroleum industry and centrifugal pump engineering. Holder of a professional engineer's license, his experience has been gained in California, New York, South America, as well as through many years in the Mid-Continent area.

Glenn O. Hopkins has been named public relations director and advertising manager of Refinery Engineering Company of Tulsa, Oklahoma. Hopkins received his BS degree in education at Kansas State Teachers College at Pittsburg, Kansas. Following this he was for 10 years a teacher in grade, junior high, and high schools in Kansas. During the war he was for two and a half years an instructor on U. S. Air Force mechanic and cadet training programs at Spartan School of Aeronautics. Following this until joining Refinery Engineering Company, he served as advancement manager, advertising manager, and Veterans Administration contract officer for the school.

G. O. Hopkins

Ferdinand Pauls has been appointed assistant advertising manager of James P. Marsh Corporation, Skokie, Illinois. Pauls, a graduate of Northwestern University, has been active in the Marsh sales department for about 10 years.

Alfonso ("Al") Morrison has been named field service engineer to the Gulf Coast division, Technical Oil Tool Corporation, headed by R. L. O'Rear. Morrison will be stationed in Victoria, Texas, and Continental Supply Company stores at El Campo and Refugio, Texas.

A. Morrison

Frank Mussell, Eastern territory manager for Allis-Chalmers Tractor division, has been appointed director of agricultural machine and implement division of industrial and agricultural equipment bureau of National Production Authority, with headquarters at Washington, D. C. Mussell is well known in the agricultural tractor and implement field. Associating himself with Allis-Chalmers Manufacturing Company in 1936, he progressed in the company to branch sales manager, and later branch manager. In 1942 he was appointed Eastern territory manager.

Donald C. Holtz has been named manager of the new Dallas orifice meter assembly plant and warehouse, American Meter Company. Holtz was first employed at the Erie factory of American Meter in 1935 and was engaged in production work until 1940. During World War II Holtz served four years in the U. S. A. Corps of Engineers and was assigned for one year to the Office of Strategic Service in the China theater.

D. C. Holtz

John L. Mortimer, Gulf-Southwest district director in the public relations department of United States Steel has been named district director in the Southeast district in addition to retaining his former duties. This promotion puts Mortimer in charge of the public relations activities over the 11-state Southern area from Texas to North Carolina. His headquarters will be at Birmingham, Alabama. He attended Rice Institute and the University of Missouri and joined U. S. Steel in 1943.

R. Clay Bailey, field representative, in the public relations department was named associate director of the Gulf-Southwest district. **S. T. McGinnis** was named associate director in the Southeast district. Bailey, a graduate of Birmingham-Southern College in Alabama and the University of Texas was radio and television editor on the Dallas Morning News before his appointment as field representative in the Southwest for U. S. Steel last March 1.

Finley C. Nicholson has been appointed to the newly-created post of manager of operations of The Davison Chemical Corporation. He will be in charge of all company production operations, except for the mixed fertilizer division. A graduate of Purdue in chemical engineering, Nicholson has been with Davison in various capacities since 1942, most recently as manager of the Cincinnati catalyst plant. He is succeeded in the latter position by **J. W. Long,** formerly superintendent of silica gel operations, stationed at Davison's Curtis Bay (Baltimore) plant.

— DEATHS —

James M. Thompson, division manager of the Southwest Division of The National Supply Company, died December 26, three days prior to his 53rd birthday.

Thompson was graduated from Virginia Military Institute in 1919. He was associated with the Norvell-Wilder Supply Company from 1934, until 1940, when he was appointed division tubular manager, Texas Division, Fort Worth, by The National Supply Company.

EMULSION BREAKER TEST REPORT

Or How To Do a Better Treating Job with 84% Less Chemical

GIVEN below is as unbiased a field test of emulsion-breaker performance as it is believed possible to secure. All production factors (except the quantities of chemicals used, and first-test circulation and recycling) were kept uniform throughout. Each entry indicates one day's production; the tests following one another chronologically on normal production schedules.

These tests were made to determine the most efficient and economical emulsion-breaker treatment *for the producer.* Neither Visco nor any competitive manufacturer or service organization supervised the tests; and no changes in the respective emulsion-breaker formulas or dosages were made during the trial periods after initially-recommended dosages by field service representatives.

Dollar-wise, without consideration of time and labor savings, Visco cost was *$0.99 per 100 barrels less . . . over 6 times the amount of dry oil was produced per gallon of Visco . . . and no circulating or recycling was necessary with Visco.*

FIRST TEST RUN

TEST DAY	OIL PRODUCED, BARRELS	GRAVITY	% B. S. & W.	AVERAGE CHEMICAL INJECTED	REMARKS
1	165.35	31.2	0.2	1 gallon	Tank Bottom Recycled
3	30.31			"	
4	331.22			"	
5	179.14			"	
6	176.96	31.3	0.3	"	Tank Bottom Recycled
7	181.92			"	
9	31.68	32.7	0.2	"	Tank Bottom Recycled
10		32.7	0.2	"	Tank Bottom Recycled
12	174.89			"	
13	77.19			"	
14	53.97			"	
18	11.71	33.7	0.1	"	Tank Bottom Recycled
19	379.60			"	
20	191.62			"	
22	86.71			"	
25	5.52	32.2	0.2	"	Tank Bottom Recycled
26	157.31			"	
28	187.72			"	
29	242.73			"	
32	77.83	31.6	0.3	"	Tank Bottom Recycled
33	76.25			"	
TOTAL	2819.63			21 gallons	

134.27 bbls. dry oil/gallon of chemical

SECOND TEST RUN WITH VISCO

TEST DAY	OIL PRODUCED, BARRELS	GRAVITY	% B. S. & W.	AVG. VISCO CHEMICAL INJECTED	REMARKS
34	273.70			0.692 qts.	
35	144.75			"	
36	89.58	31.8	0.2	"	
40	15.72	32.3	0.2	"	
41	38.77			"	
43	215.72			"	
44	132.33			"	
47	258.20			"	
48	136.43			"	
49	128.10			"	
50	66.12			"	NO RECYCLING OR CIRCULATION NECESSARY WITH VISCO TREATMENT
54	218.45	32.6	0.2	"	
55	186.05	31.3	0.2	"	
56	97.98			"	
57	212.19			"	
58	119.85			"	
59	4.13			"	
60	296.99	32.6	0.2	"	
61	194.81	32.4	0.2	"	
64	59.26			"	
65	299.09			"	
66	73.01	32.6	0.2	"	
70	110.74			"	
71	211.75			"	
72	126.78	31.7	0.3	"	
TOTAL	3710.50			4.325 gallons	

857.91 bbls. dry oil/gallon of Visco

Phone Visco for fast action on efficient, economical emulsion-breakers for your use . . . Visco welcomes comparative cost-speed-quality tests on any emulsions in any field. Call Houston, CAPITOL 7300, collect, now!

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building • Houston 2, Texas

Visco... **CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS**

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554; 2,454,808; 2,514,399. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.

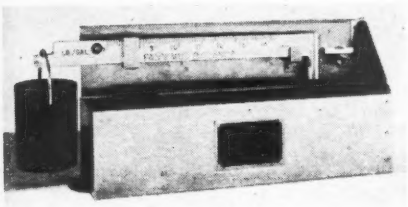
New Machinery and Supplies

Use reply card to procure promptly complete information and prices of products described here in brief.

Circle corresponding letter or letters on reply card.

(A) MUD BALANCE

An improved accurate balance for determining the density of drilling mud samples and other fluids is being marketed under the name Fann mud bal-



ance, Model 10. It operates by means of a counterweight balancing system measuring a predetermined small volume. The instrument consists of combination case and base, a beam graduated in pounds per gallon, a hard rubber mud sample cup, detachable cap, slide bar, and counterweights. Its stainless steel mounting case is designed so that the beam is protected from the wind and unnecessary handling. The complete instrument with case weighs 2¾ lb and dimensions are 3½ by 3½ by 12¾ in. Its range is from 7 to 21 lb per gal. Geophysical Machine Works.

Circle letter (A) on reply card.

(B) DIESEL ENGINE

Addition of a new, three cylinder diesel engine, rated at 30 to 45 hp within a speed range of 1200 to 1800 rpm, is announced by Nordberg Manufacturing Company. The new power unit supplements the Nordberg 4FS one and two cylinder, 10 to 30 hp diesel engines. This new engine, known as the 4FS3 has a 4½ in. bore and 5¼ in. stroke and is a four-cycle, vertical, mechanical injection diesel engine. Built as a complete, self-contained, ready to operate unit, it is available as an electric generator set, pumping unit, and with clutch or stub shaft power take-off for direct connection or belt drive.

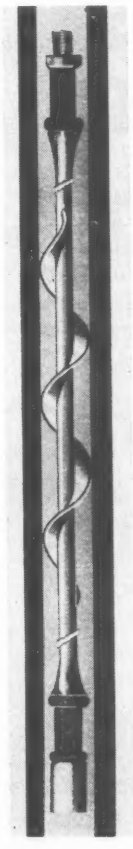
Built with side suction, two ball bearing pumps, with statically and dynamically balanced impellers, the Nordberg 4FS3 pumping unit has a capacity of 500 to 3000 gpm at 20 to 220 ft head. Its compact design and smooth efficient operation makes it particularly applicable for washing, draining, dredging and general pumping service in the contracting and quarry industries. Also it is equally well suited for use in the irrigation field for sprinkler or flood irrigation.

Circle letter (B) on reply card.

(C) CEMENT COMPOUND

Anchor bolts for permanently fastening machinery, hand rails, seats, or equipment of any type to concrete, can now be set easily, using Por-Rok quick setting cement, according to the Hallemite Manufacturing Company. Por-Rok replaces critical lead and sulfur for most bolt-setting operations. Applied cold, there is no heating hazard. Por-Rok is easy to use—drill hole, set bolt in place, mix Por-Rok with water, and pour into opening around bolt. Within 15 to 30 minutes, the bolt is anchored permanently. Por-Rok is self-bonding, self-levelling, oil-resistant, and will not shrink. It has a compression strength of 4500 lb psi.

Circle letter (C) on reply card.



(D) SPIRAL PARAFFIN SCRAPER

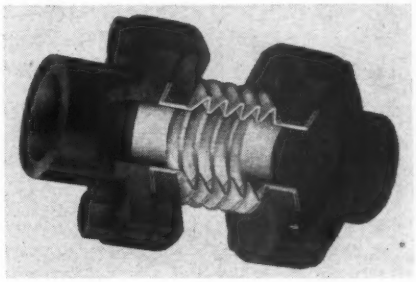
A paraffin scraper that can be installed in a matter of a few minutes at the well site by the crew is now available. The product is known as the Triple-Spiral paraffin scraper and has been used successfully by major and independent operators in practically every area in which paraffin in pumping wells is a problem.

The Triple-Spiral is made of spring steel, blade die formed, and heat treated to form a triple spiral the ID of the hole ⅛-in. less than the OD of the rod, insuring a spring tension grip on the rod. The product has been tested for resistance to slippage and found to resist 2350 lb pressure before slipping.

Circle letter (D) on reply card.

(E) BELLOWS CONNECTOR

Fabricated of chemically inert Teflon, the new "John Crane" bellows type connector has many pipe line applications where vibration, expansion, and electro-



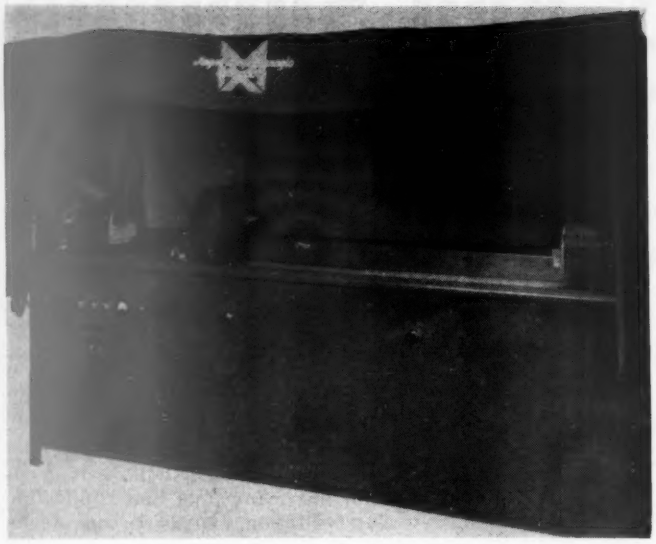
lysis exist in the handling of corrosive liquids or gases and solvents. The new connector is electrically non-conductive, flexible even at —94 F and as strong at 480 F as at 70 F, according to the manufacturer. This bellows connector serves as a vibration dampener as well as an expansion joint — connects misaligned couplings and insulates flanges electrically. End flanges of the joint are French-type envelope gaskets made integral with the joint for easy assembly between companion flanges and a tight, leak-proof seal on installation. Crane Packing Company.

Circle letter (E) on reply card.

(F) CONNECTING LINKS

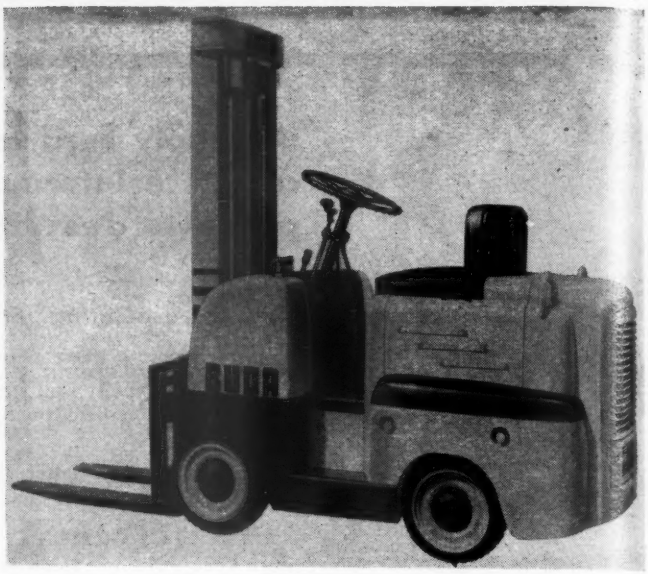
The introduction of a "universal" design in Wedglok safety connecting links for carbon and alloy chain users has been announced by the Interstate Drop Forge Company. Only two sizes of Wedglok universal links are needed to connect any size chain from ¼ to ¾ in., depending upon the type of chain used. Thus, distributors and users need not maintain complicated stocks for making chain or wire rope connections or emergency repairs, etc. Also Wedglok links permit users to make up chain slings safely from running lengths of chain. They can assemble slings quickly right on the job—without special equipment, to fit their exact needs. Other Wedglok links are available in sizes up to 3 in. The spacer is in compression when the link is carrying a load, and it will not shear or loosen if the projecting spacer points are properly peened.

Circle letter (F) on reply card.



New equipment for magnetic particle inspection.

New fork lift truck developed by The Buda Company.



(G) MAGNETIC INSPECTION

A complete re-engineering by Magnaflux Corporation is announced, creating a full new line of equipment for magnetic particle inspection. This has greatly improved delivery time and in many instances, reduced costs to meet the expanding needs for non-destructive testing created by the needs of the national defense program. This was done while "special" inspection equipment requirements were making excessive demands upon the company's engineering facilities during 1951. A number of detail improvements were made on the new line of standard units. In most cases the new units are larger than the old units at comparable price,—from 48 old to 54 in. new capacity, and from 72 old to 96 in. new. The new units can handle a greater diversity of parts for inspection. They are now built for either 220 or 440 volts, 60 cycle, interchangeably.

Circle letter (G) on reply card.

(H) FORK LIFT TRUCKS

The FT series of fork lift trucks, completely new from the ground up, is being announced by The Buda Company. The new Buda "safelined" designed FT series of fork lift trucks powered with either a Buda diesel or Buda gasoline engine, are available in 12 models on solid or cushion tires in capacities of 3000, 4000, 5000, 6000, and 7500 lb at a 24 in. load center and 4000 lb capacity at an 18 in. load center. Special features include: All roller construction mast with special rolled mast channels; two speeds forward and two speeds reverse single lever gear shift; quick change heavy duty clutch, and many others.

Circle letter (H) on reply card.

(I) ROTARY PUMP

A new De Laval-IMO A313B pump has been announced by De Laval Steam Turbine Company. This IMO is designed to handle a wide variety of oil handling applications for pressures up to 275 psi. This new rotary positive displacement pump offers all the advantages of the IMO design. It has only three moving parts and can be used for capacities to 80 gpm, pressures to 275 psi, and intermittent pressures up to 325 psi. This new IMO handles light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, and similar services.

Circle letter (I) on reply card.

(J) STEAM GENERATOR

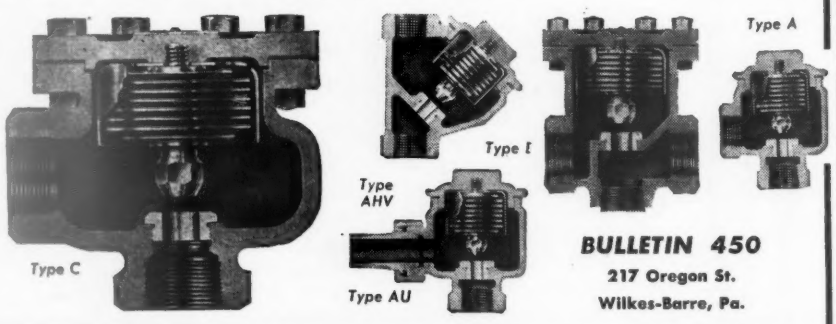
Simplicity in design and construction is dominant in the new "Continental" packaged steam generator announced by the Boiler Engineering and Supply Company. Fully automatic and self-contained, it is said to be easy to install, highly efficient, and economical to maintain. One of the boiler's important features is that front and back can be opened in 15-20 minutes, providing ready access for interior cleaning and servicing. Generator is ready to operate when service connections are made.

Circle letter (J) on reply card.

Nicholson Traps Help

CUT STEAM COST $500,000 A YEAR

At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for Bulletin 450.

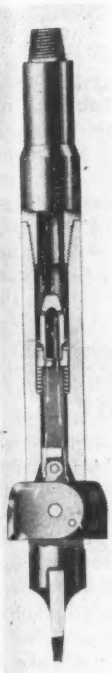


BULLETIN 450
217 Oregon St.
Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

(K) HYDRAULIC EXPANSION WALL SCRAPER



Grant Oil Tool has developed a hydraulic expansion wall scraper, which is a two-bladed tool that has many important applications. It may be used to scrape the face of a producing formation and facilitate fluid flow into the hole; to open short, tight spots before running casing; to form enlarged pockets for gravel packing; and to increase the diameter of the hole at cementing points to improve the efficiency of the cement job. For directional drilling the wall scraper can be provided with a bull nose that extends well below the blade slot. This helps to stabilize the tool when in operation. A bottom hole wall scraper with body terminating at the lower end of the blade slot is available for enlarging the last few feet of hole. The scraper blades in both tools are extended by the pressure of the circulating fluid which is controlled at the pumps by the driller.

Circle letter (K) on reply card.

(L) COOLING TOWER

The Marley Company, Inc. has a new water cooling tower for use wherever intermediate capacities of cold water are required. Outstanding features of the new tower, according to the manufacturer, include: Its height, 7½ ft for the 150-ton unit, is lower than that of any other cooling tower of similar capacity; pumping head and required fan horsepower are low for any given capacity and design performance; first water cooling tower in the "medium-capacity" range to use the patented double flow principle — one fan utilizing air from two completely open sides, and many others. The new aquatower comes in 7 sizes, beginning with a 50-ton unit.

Circle letter (L) on reply card.

(M) ROAD GRADERS

The Meili-Blumberg Corporation has placed into production a new series of road graders known as the Models 42, single drive, and 44, tandem drive, incorporating unusual design features. This series of graders in the 40 hp class weigh up to 15,000 lb, carry 10 or 12 ft blade, and are perfectly suited for medium class, ditch to ditch service, with 1:1 slopes. These units have been designed to fill the gap between the light 30 hp maintenance grader and the high priced heavy duty machines. Most unique general feature of these units is that they can be purchased to fit particular job requirements.

Circle letter (M) on reply card.

(N) LIQUID STEEL

Slip-On, Inc., has developed a new liquid stainless steel, which is a protective coating consisting of actual stainless steel reduced by a new process to a microscopically fine form (flakes). It is combined with vinyl plastics to form a quick drying liquid that will give a surface of actual stainless steel in coating form to protect against rust and corrosion. It is claimed by the makers to offer impermeability to moisture, of type 18/8 No. 302 stainless steel. The metal is present in the form of flakes that overlap and interlock as the coating dries, presenting an almost continuous barrier of stainless steel to corrosive materials. Liquid stainless steel can be sprayed, brushed, or dipped.

Circle letter (N) on reply card.

(O) LIMIT SWITCH

A new rotating-type limit switch for application where reversing operating is to be co-ordinated with the number of revolutions of a motor shaft or driven equipment has been announced by the General Electric Company's control department. Superseding four previous forms, the new switch can be used to control motor-operated doors and windows, valves on machine tools, baling operations, travel limits on machinery, etc. The switch consists of two size 2 switchettes each having one normally open and one normally closed circuit.

Circle letter (O) on reply card.

How To Stop Scale in Diesel Cooling Systems

PROBLEM: Scale in Diesel cooling systems—building up 2 inches in about 6 weeks . . . impairing engine efficiency . . . often resulting in cracked heads and blocks.

SOLUTION: Add small amount of Oakite Airefiner 52 to jacket cooling water.

RESULTS: No descaling necessary after 15 months of operation . . . all engines operating at proper temperature . . . cost of maintenance reduced 87% . . . manual labor eliminated.

That's the experience of a Texas Producer. It could be yours, too. Call your local Oakite Technical Service Representative. Or write Oakite Products Inc., 48 Thames St., New York 6, N. Y.

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Technical Service Representatives Located in Principal Cities of United States and Canada

ROPER rotary PUMPS

DEPENDABLE SERVICE FOR A WIDE RANGE OF USES

- Quiet
- Efficient
- Economical

SERIES "K"

The *Series K* pump shown — for hydraulic service and fuel supply — is one of four standard models in the Roper line. Others include: *Series F* for use with clean liquids of all kinds; *Series H* for high pressure applications, especially hydraulic mechanisms; and *Series 3600* for general purpose work handling thin or thick liquids. Roper Pumps are noted for quiet operation, high volumetric efficiency, and ruggedness coupled with compact design. Models are standard fitted or bronze fitted; can be supplied with or without built-in relief valve. Sizes range from 3/4 to 300 G.P.M. — Pressures to 1000 P.S.I. Send for catalog to know complete details.

GEO. D. ROPER CORP.
722 Blackhawk Park Ave.
Rockford, Illinois

ROPER Rotary Pumps

Trade Literature

Publications will be sent free.

(P) FILTER GAGES

Builders-Providence, Inc., has announced a new bulletin on filter gages, mechanically operated, describing the various models of filter gages it manufactures. In addition to the description of these instruments, this bulletin also briefly relates the principle of operation used in these gages. The diaphragm pendulum unit, which is usually an integral part necessary in the operation of most filter gages is discussed pointing out its features. Many of gages are used for recording water level in which case the diaphragm pendulum unit is not needed. A few special gages are also considered in this bulletin.

Circle letter (P) on reply card.

(Q) HEAT EXCHANGERS

A new heat exchanger bulletin has been issued by Corning Glass Works. This bulletin contains a series of charts and nomographs that greatly simplify the calculation of heat transfer requirements. Data are also given for a newly designed cascade type heat exchanger. These coolers are now available in standard complete units to meet various requirements. Utilizing specially constructed Pyrex brand glass heat exchange tubes, the coolers provide an efficient economical means of cooling corrosive liquids. Because of the high resistance to corrosion, inexpensive coolants, such as raw or sea water, may be used.

Circle letter (Q) on reply card.

(R) WIRE ROPE

The Colorado Fuel and Iron Corporation has issued a new 2-color 112-page handbook on wire rope with ton mile tables. The length of a wire rope is determined by the requirements of the operation on which it is to be used. Wickwire Spencer division manufactures wire rope in a full range of sizes to meet the requirements of all types of equipment. The strength of wire rope is determined by its size, grade, and construction. In most cases, rope-using equipment has been designed for a specific size rope so that there is generally no leeway in the selection of the proper size to use. The book contains useful data and index, tables for sizes of drill pipe, characteristics of wire rope, cable tool drilling, rotary drilling.

The company has also published a booklet titled "Rotary Drilling Line 'Ton Mile' Charts." It is a pad of Form WD89 to keep an accurate record of the wear of rotary drilling lines.

Circle letter (R) on reply card.

(S) SOIL COMPACTION

Detailed information, including useful new production data, for figuring work schedules and costs on soil compaction jobs is contained in a new bul-

letin just published by Barco Manufacturing Company, of Chicago, Illinois, covering the use of the Barco portable gasoline "Rammer" for tamping fill or back-fill in restricted areas. Of special interest to builders, contractors, supervisory engineers, and project managers is a discussion of the use of "soil compaction" as a means of attaining (1) greater permanence, (2) lower costs, and (3) earlier completion dates on many construction projects.

Circle letter (S) on reply card.

(T) VALVE LUBRICATION

Minneapolis-Honeywell Regulator Company has reprinted an article entitled "Proper Valve Lubrication . . . A Prerequisite to Good Control." The article discusses the importance of proper valve lubrication in keeping valves operating at peak efficiency. Also covered are the function, proper selection, methods of application, and the various types of lubricants in general use.

Circle letter (T) on reply card.

(U) METAL, ALLOYS

A new, four-page bulletin, "Brief Facts About Ampco Metal and Other Ampco Alloys," has just been released by Ampco Metal, Inc. Information about the uses of Ampco metal and Ampcoloy alloys in bearings, gears, cams, dies, wear strips, etc., is given. The corrosion resistant applications as well as physical properties and photomicrographs of the alloy are included.

Circle letter (U) on reply card.

(V) HEAT PROCESSING

Processing is defined broadly as "a series of precise preparations to achieve either a better product, more production, lower unit costs—most often a combination of all three," in a new bulletin, "Why Heat Processing," issued by Selas Corporation of America. The bulletin emphasizes the increasing need for precision in heat processing that is comparable with the precision in chemical compounding, metal machining, glass forming, paper making, and textile production. Principles of heat application to a wide variety of solid and fluid products are illustrated and described in the new bulletin.

Circle letter (V) on reply card.

(W) GENERATOR UNIT

Design and construction features of Allis-Chalmers WA-Series steam turbine generator units manufactured in NEMA ratings of 2000 to 7500 kw are described in a new bulletin released by the company. According to the bulletin, the WA-series units are built in the condensing type, for power generation only, and in the non-condensing and automatic extraction types to provide a steam-power balance where process steam is used. Allis-Chalmers Manufacturing Company.

Circle letter (W) on reply card.

(X) ROTARY TABLES

IDECO has released a new 12-page bulletin describing its complete line of oil bath rotary tables. Major improvements are: New top and bottom seals that prevent mud or water from entering the table; re-designed oil sumps and bearing arrangement; and the addition of a new 23-in. rotary table with splined opening in the table. First introduced in the 14½-in. table, the splined opening has proved successful in reducing master bushing wear, and also facilitates faster engagement of the Kelly drive with the table. The text is supplemented with photographs and exploded views showing working parts and construction details. Other related IDECO products are described. These include the new roller kelly drive with pilot tube, rathole drilling equipment, and independently powered hydro-rotary units.

Circle letter (X) on reply card.

(Y) MODERN GAS ENGINE

"The Modern Gas Engine," a paper presented at the Oil and Gas Power Conference of the American Society of Mechanical Engineers is now available in bound form. Written by Ralph L. Boyer and W. R. Crooks of The Cooper-Bessemer Corporation, the paper provides data, photographs, and charts on the development of the large internal combustion engines used for pipe line transmission service and electric power generation. It discusses also the installation and operating economies of different types of design on their various services. Bound copies are available.

Circle letter (Y) on reply card.

(Z) PUMPS

Construction details on Allis-Chalmers grease-lubricated pedestal-mounted general purpose pumps (Type SSB) are given in a new bulletin released by the company. The pumps, available in capacities to 2500 gal per minute at heads to 550 ft, can be had with stuffing box or mechanical seal, direct coupling or V-belt drive, and in a choice of materials. One of the many combinations of materials and seals possible with this pump will handle almost any liquid at temperatures to 250 F. Allis-Chalmers Manufacturing Company.

Circle letter (Z) on reply card.

(AA) CENTRIFUGAL BLOWERS

Construction features of Allis-Chalmers multi-stage Type V centrifugal blowers for equivalent air pressures above 6.5 psig and inlet volumes above 1500 cfm are described in a new bulletin released by Allis-Chalmers. Illustrations include a complete cross-section of a multi-stage Type V gas exhauster, photographs of components of multi-stage Type V blowers, of two-stage, three-stage, and four-stage blowers with the tops of their casings removed, and of typical installations in a variety of industries. Allis-Chalmers Manufacturing Company.

Circle letter (AA) on reply card.

(AB) PROTECTIVE COATINGS

Reilly Tar and Chemical Corporation has just published a new 24-page booklet on Reilly protective coatings for metal surfaces exposed to corrosion, tuberculation, and incrustation. Covering hot application enamels, primers and coupling compounds, cold application enamels and bituminous paints, the booklet outlines properties, uses, containers, performance tests and application procedure for coatings, etc. Photographs of pipe and other surfaces that have been protected with Reilly enamels illustrate the booklet.

Circle letter (AB) on reply card.

(AC) BRIDGE FLOORING

Until IQ-35 rectangular steel bridge flooring was developed, Kerlow Steel Flooring Company made two types of bridge gratings, VQ-standard, which was about 2½ in. deep, weighed about 15 lb, and required 10 lb of auxiliary stringers, and the Kerlow VQ35 heavy-duty grating, a later development. The newest type of flooring, however is the IQ-35, which may be laid either longitudinally or transversely on a bridge, it will carry H20 loading on a 15 in. circle up to a span of 48-in. and weighs about 19 lb. IQ-35 is made with grating parallel with traffic and transverse to traffic. In the latter type, the transverse bars that the tires ride on are placed higher than the longitudinal bars and the transverse bars are serrated to enable tires to maintain or to develop greater traction for emergency stopping.

Circle letter (AC) on reply card.

(AD) TUBE FITTINGS

A new 76-page catalog of The Parker Appliance Company combines in a single volume complete data on tube fittings and tube-to-pipe adapters, fabricating equipment, and pertinent data on engineering selection and installation. Photos, drawings, and dimensional tables are included for all shapes of the Triple-lok standard 3-piece flared fitting in brass, aluminum, steel, and stainless; the Ferulok flareless fitting in steel; precision machined pipe fittings, and tubing, tube clips, tube cutters, benders, and flaring tools. The data section includes six pages of "How-to-do-it" photos and eight pages of valuable selection charts relating tube size to such variables as velocity and flow, differing service conditions, allowable stress, temperatures, and pressures.

Circle letter (AD) on reply card.

(AE) GAGES

Jerguson Gage and Valve Company has released a data sheet on its non-frosting gages. These non-frosting gages are indicated wherever it is desired to measure liquid levels accurately in process involving low temperature fluids, in the chemical, petroleum, and other process industries. They are built with a special patented frost preventing unit, consisting of a flanged piece of transparent Lucite in direct contact with the gage glass. The leaflet has holes for insertion in a notebook, with photographs, and diagram cutaway on both sides.

Circle letter (AE) on reply card.

(AF) INSULATION

A booklet containing new information about the use of hydrous calcium silicate insulation has been compiled by the Kaylo Division of Owens-Illinois Glass Company. The eight-page publication is illustrated with graphs, tables, and drawings depicting the numerous ways in which Kaylo heat insulation is used in industrial and commercial projects for temperatures as high as 1200 F. It lists the wide selection of shapes and sizes available to insulate tubes and pipes from ¼ to 72-in diameters and vessels from 72 in to 60 ft, as well as flat surfaces.

Circle letter (AF) on reply card.

(AG) WIRE PRODUCTS

A colorful wall chart listing all of the Ampco bronze weldrod and wire products available by trade name, together with AWS-ASTM designation, has just been released by Ampco Metal, Inc. In addition, and opposite the trade names, is descriptive information, typical applications, mechanical properties, deposit chemical composition, recommended current and polarity, N.E.M.A. color markings, and diameter sizes. Also included is a copy of the "Bronze Electrodes Selection and Preheat Chart" making an easy and convenient reference and check list. The chart is illustrated with many application pictures.

Circle letter (AG) on reply card.

(AH) PROCESS VALVES

The W-K-M Company has published a 2-color, 4-page bulletin on its process plant valves. The brochure contains a cutaway diagram of the valve, lists engineer and operational advantages of W-K-M valves, one of which is the lever-lock assembly. This is a mechanical device that positively holds the gate and segment in neutral position, while the valve is being opened or closed, and permits expansion of the gate assembly at the proper time for seating in opened or closed position.

Circle letter (AH) on reply card.

(AI) STEEL CASTINGS

The International Nickel Company, Inc., has published a 32-page bulletin on nickel alloy steel castings in industry. Over 100 illustrations are included in this booklet, which reports on steel, cast to shape, as a reliable engineering material. Cast steels meet exacting service requirements and the continued demand of industry for increased power, higher speeds, heavier loads, and longer service life in machinery and equipment parts that can be made most economically and efficiently in cast form. Advantages and recommended specifications and compositions for typical service applications are given. Strength is assured by use of nickel and other alloying elements.

Circle letter (AI) on reply card.

(AJ) MAST AND RIGS

IDECO recently announced the publication of a new 16-page bulletin describing its IDECO Kwik-Lift mast and rambler rigs. Included in this bulletin is the new IDECO Type "C" Kwik-Lift mast featuring fast rigging-up and moving, clear visibility, and maximum net hook capacity per pound of mast weight. The text is supplemented with photographs and exploded views showing working parts and construction details. A table of specifications, including capacities, road height, racking capacity, and total weight, is included.

Circle letter (AJ) on reply card.

(AK) EXPANSION ROOF

A new, well illustrated 18-page bulletin has been published by Graver Tank and Manufacturing Company, Inc. The booklet is a thorough description of the Graver expansion roof, first conservation roof design to be developed, and claimed by the manufacturer to be the most efficient of its type. The Graver expansion roof tank is an efficient method of retaining expanding vapors within the tank. The normal vapor space extends from the top of liquid contents of the tank to the underside of the roof. This space becomes variable in capacity, with increase or decrease of liquid contents, contraction or expansion of vapors in accordance with the temperature. A cut-away diagram shows standard fittings, special fittings, and various graphs and charts present detailed data on the subject of evaporation.

Circle letter (AK) on reply card.

(AL) PLUG VALVE

A new fully-descriptive catalog covering the entire line of Porter lubricated plug valves is now available. By means of cross-section and cut-a-way illustrations as well as line drawings the unusual features of this modern design valve are presented. The Porter valve is particularly adapted for use where positive, leak-proof operation as well as corrosion resistance is demanded. The oil, gas, chemical, and process industries use vast numbers of lubricated plug valves. Sizes of the Porter valve range from ½ in. to 12 in. Information on working pressures, materials of construction, design and function, manufacturing methods, accessories, lubricants, and pressure and temperature ratings is also included. H. K. Porter Company, Inc.

Circle letter (AL) on reply card.

(AM) ROTARY SWIVEL

The Guiberson Corporation has issued a 4-page bulletin on its Type "A" rotary swivel. This particular swivel is recommended by the manufacturer for slim-hole drilling, work-overs, and clean out work. A full-floating wash pipe of the same design used on Guiberson rotating drilling heads is one of the features of the swivel. The wash pipe needs no adjustment, can be pressure gun lubricated while on the well and cannot transmit pressure squeeze from one seal ring to another. The bulletin contains information on installation, suggestions for changing washpipe, lubrication pointers, a table of engineering data, and a price and parts list.

Circle letter (AM) on reply card.

(AN) REGULATING VALVE

Bulletin 700, just issued by Spence Engineering Company, features a large cutaway illustration of a typical Spence pilot-operated regulating valve with detailed explanations of five design features. In addition, a panel is devoted to showing how the control function of a Spence regulator can be changed by using a different sensitive pilot. The 4-page bulletin also carries a partial list of users and a complete list of representatives.

Circle letter (AN) on reply card.

(AO) ECONOMICAL TRACTOR OPERATION

"Standardization—Key to Economy" is the title of a new 16-page booklet recently issued by Caterpillar Tractor Company. This well illustrated booklet shows how contractors and others who use earthmoving equipment and diesel power can operate more economically, with greater security and protection, by standardizing on "Caterpillar" products. The booklet points out that the economy of having two or more like power units on the same job is the interchangeability of parts. The fact that some 97 manufacturers use "Cat" diesel engines in their products adds to the effectiveness of this interchangeability.

Circle letter (AO) on reply card.

(AP) DIAPHRAGM OPERATORS

A new 12-page catalog No. 1700, recently published by Minneapolis-Honeywell Regulator Company, covers the use of Honeywell Air-O-Motor diaphragm operators with Continental butterfly valves. Complete specification data is given for both standard and heavy duty pattern valves. A wide selection of diaphragm operators is shown and described. Also included are material specifications, mounting dimensions, maximum pressure ratings, and easy-to-follow selecting and ordering information.

Circle letter (AP) on reply card.

(AQ) EXPANSION JOINTS

An illustrated catalog describing all types of corrugated expansion joints has just been released by Flexonics Corporation, formerly Chicago Metal Hose Corporation, Maywood, Illinois. This catalog gives complete specification and installation data for Flexonics-type free-flexing joints, for low pressure applications; controlled-flexing joints, for greater amounts of traverse, and Flexoniflex joints for extremely high pressure applications. Also covered are dual, hinged, balanced, and bulkhead units.

Circle letter (AQ) on reply card.

(AR) SAFETY VALVES

Otis Pressure Control, Inc., has published an eight-page bulletin on its various types of safety valves. It is complete with cutaway diagrams, tables of critical dimensions data, and numerous pictures, and illustrations. The Otis surface safety valve is a full-opening gate valve pressure-operated to close automatically in case of abnormal pressure changes. The other is the Otis Type A, which is used for flow lines not requiring full-opening valves. Third, is the tubing safety valves, called removable "storm chokes" for automatic, sub-surface protection against wild, uncontrolled flow.

Circle letter (AR) on reply card.

(AS) POWER PIPING

Taylor Forge and Pipe Works has published a reprint of the article, "How to Use Schedule Numbers in Power Piping Design," by Sabin Crocker. A chart contained in the article will prove very useful, the company believes, because the information is calculated on the basis of the new formulas both by the ASME Boiler Code and the ASA Code for Pressure Piping, and secondly because the data in this chart reflect the pipe wall tolerances and the designer can make his selections without having to convert from nominal wall to minimum wall. The article contains a chart on the back cover submitted by Taylor Forge, which tabulates the 1000 by

$$\frac{P}{S}$$

values for standard wall, extra strong wall, and double extra strong wall pipe.

Circle letter (AS) on reply card.

(AT) DIGGING TEETH

The H. and L. Tooth Company, manufacturer of two-part teeth, has published a 2-color brochure picturing its products. The sharp teeth manufactured by the company feature positive locking flex-pin connection, and are depicted on a clamshell, ripper, scarifier, loader, trencher, shovel dipper, hoe bucket, and dragline.

Circle letter (AT) on reply card.

(AU) PLANT FACILITIES

Kelley Manufacturing Company is offering a 6-page brochure to manufacturers describing facilities of the Kelley plant. Long one of the largest metal stamping plants in the southwest, Kelley has gained valuable experience in all forms of metal stamping and drawing. Brochure shows Kelley plant, describes departments and operations, shows sample pieces made by Kelley for other leading southwestern manufacturers.

Circle letter (AU) on reply card.

(AV) FLUE GAS ANALYZER

Minneapolis-Honeywell Regulator Company has issued a new instrumentation data sheet 10.15-3a describing the Davis indicating and recording flue gas analyzer. The recorder utilizes a Davis thermal conductivity gas analyzer in combination with a Brown ElectroniK recorder. The combined apparatus provides continuous recorded combustion control analysis. The data sheet describes the equipment and explains how it is used for combustion control analysis and describes the operation and construction of the apparatus. Photographic illustrations and schematic diagrams facilitate the explanation of the device and are included in the four-page data sheet.

Circle letter (AV) on reply card.

(AW) COOLING SCRUBBING TOWERS

A new 4-page bulletin just out illustrates and describes towers built by Aqua-Therm Inc. The distinguishing feature of these towers is the stoneware saddle fill, which provides 50 sq ft surface area for each cubic foot of volume. The saving of space is said to permit a 40 to 70 per cent reduction of customary tower height; a 20 per cent reduction of basin area, and a 50 per cent reduction of pumping head.

Circle letter (AW) on reply card.

(AX) REFRACTORIES

Ramtite Company has published a new 24-page catalog and data book entitled, "Boiler Settings with Plastic and Castable Refractories." This book contains numerous cross-sectional drawings, charts, technical illustrations, and other data—in the field of plastic and castable refractories and their applications in modern boiler settings. The Ramtite booklet also presents information about refractory manufacture, design and installation.

Circle letter (AX) on reply card.

BOOKS

"Magic Oil, Servant of the World," *by Alfred M. Leeston. Published by Juan Pablos Books, Dallas, Texas. Price, $3.75. Pages, 225.*

It is not easy to take a world petroleum picture without distortions around the edges. In order to keep a consistent view, there is a tendency to become so detached that statistics and technical operations are crowded into the foreground, and blot out the setting. Or an attempt to spell out the intricate framework surrounding the oil operations in faraway lands blurs the essential facts of development.

Dr. Leeston has achieved a remarkable balance in his description of the world petroleum industry in "Magic Oil." Brief though his account must be, there is a brisk completeness about each vignette of a nation's oil. Statistics are set against and explained by each nation's climate for industry.

From the stupendous development in the United States to the unsuccessful but still hopeful exploration in Australia, Dr. Leeston turns the spotlight on one region, then another, drawing into the background with broad strokes, the politics, economics, culture, weather, geology, and often, the prospects. Dr. Leeston is a man of high education and wide knowledge. He writes confidently of world affairs, but never dryly. His English, one of the several languages that he commands, reveals an occasional quaintism that does not detract from the book but seems to stress his earnest enthusiasm in this particular job of telling you how things are all over.

The new publisher has brought out a first book that will be a good reference book for the oil industry, a good account for laymen interested in oil, and an excellent study for the college students whose careers will be in the petroleum industry.

We have but one complaint.The new publisher needs a new proofreader. This is not, however, serious enough to detract from an otherwise valuable book.

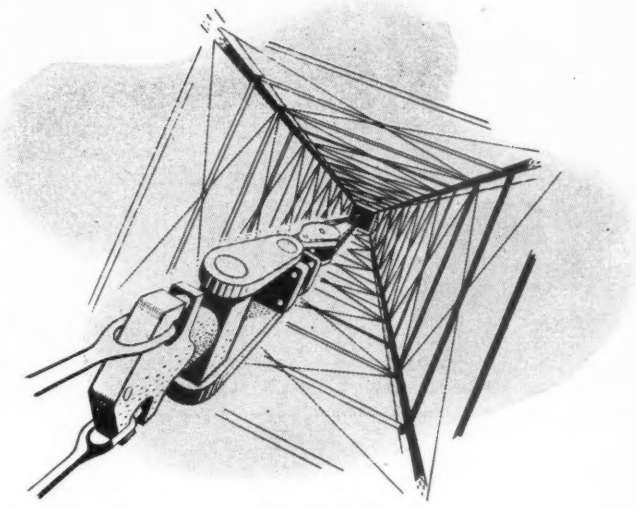
Financing Oil Production in Michigan, *by Paul C. Souder, published by Michigan National Bank, Saginaw, Michigan. Price, Free to those in the petroleum industry. Pages, 131.*

The purpose of this thesis is to outline a procedure that will enable any interested bank that is without the aid of an oil loaning officer to make a secured oil production loan with safety. The paper discusses the size of the Michigan oil industry, proration costs, types of security, methods of evaluating the security, preparation of the security instruments, and the hazards inherent in this type of loaning. Also provided is a simple check list to follow in making secured oil production loans in Michigan.

Die Katalytische Druckhydrierung von Kohlen, Teeren und Mineralolen, *by Walter Kronig (The Catalytic Pressure-Hydrogenation of Coal, Fats and Mineral Oils). Julius Springer Press, Reichspietschufer 20, West Berlin 35, Germany. Price, 39 German Marks. Pages, 266.*

Published in German, this volume gives a condensed but apparently thorough and informative resume of the various methods by which the hydrogenation of coal, fats and oils under elevated pressures is accomplished. The work contains 26 illustrations and 13 charts to amplify the text, the illustrations dealing primarily with apparatus and equipment.

The different phases of the broad subject are presented in four main divisions. It covers the employment of nascent and of molecular hydrogen in hydrogenation proceedings, use of catalysts. Fairly exhaustive discussion, with many literature references, is given covering details of high pressure operations with the raw material in slurry phase, covering both brown coal and hard coal (Steinkohle). Greater attention is given to hydrogenation of hydrocarbons of both gas oil and of light oil boiling ranges, operating in the gas phase, and of hydrogenation of aromatics to simpler, more hydrogen-rich products. An entire chapter is devoted to discussion of low pressure studies on the making of water gas from combustible materials, first step in the synthesis of hydrocarbons for example.



How Gýrol Fluid Drive smooths out draw works operations

In the operation of modern, consolidated draw works with master friction and drum friction clutches, American Blower Gýrol Fluid Drives offer important advantages.

These unique drives provide a shock-absorbing cushion for engine and machinery . . . prevent stalling. With fluid drives, it is possible to engage the clutches and pick up the hoist at higher line pulls than those normally used. Yet their flexibility over a wide range makes them ideally suited for jobs requiring light line pulls, as in fishing operations.

Protect your investment, save time, save money by using American Blower Gýrol Fluid Drives on your rigs.

For refining operations, you'll find American Blower Fans and Heating and Cooling Coils an equally sound investment. Ask your supplier.

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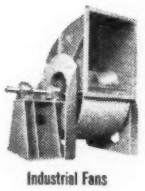
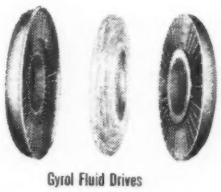
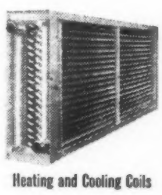
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation


Industrial Fans


Gyrol Fluid Drives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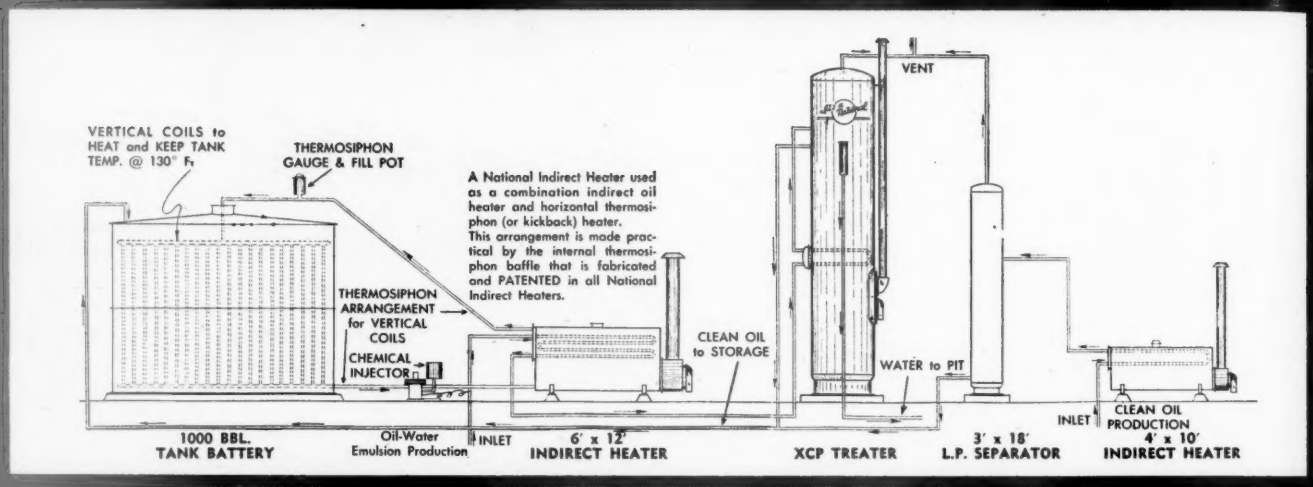
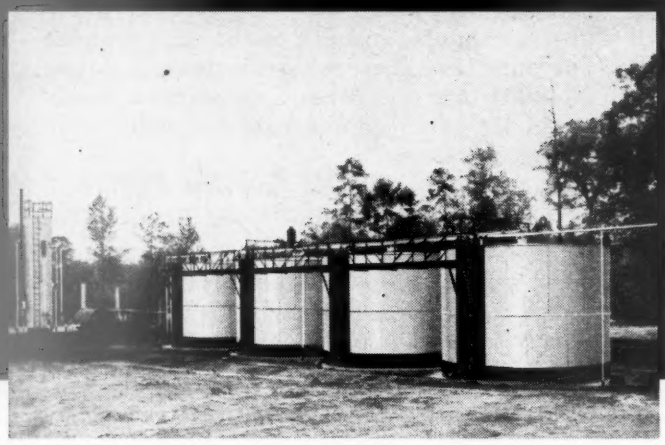
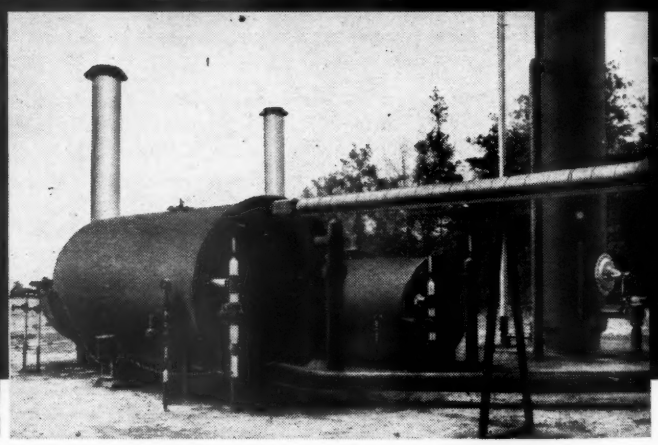
To obtain more information on products advertised see page E-41

NATIONAL SOLVES ANOTHER PROBLEM

CONDITIONS	REQUIREMENTS	SOLUTION
18° API Gravity, Asphalt Base Foaming Oil Production One Well Producing no emulsion One Well Producing 20% cut emulsion Low GOR, Approx. 200 to 1 High Temperature pour point crude	De-gas Crude Reduce Emulsion Maintain storage temp. at approx. 130° so pipeline can pump oil out of storage.	Use 4 x 10 Ind. Heater to preheat clean production for degassing. Use 3 x 18 Separator to degas clean crude. Use 6 x 12 Ind. Heater to preheat emulsion, AND to provide heat to the thermosiphon vertical coil system in storage tank. Use XCP Treater to de-gas emulsion and dewater the crude.


VERTICAL COILS to HEAT and KEEP TANK TEMP. @ 130° F.
THERMOSIPHON GAUGE & FILL POT
A National Indirect Heater used as a combination indirect oil heater and horizontal thermosiphon (or kickback) heater. This arrangement is made practical by the internal thermosiphon baffle that is fabricated and PATENTED in all National Indirect Heaters.
THERMOSIPHON ARRANGEMENT for VERTICAL COILS
CHEMICAL INJECTOR
VENT
CLEAN OIL to STORAGE
WATER to PIT
INLET
CLEAN OIL PRODUCTION
1000 BBL. TANK BATTERY
Oil-Water Emulsion Production
INLET
6' x 12' INDIRECT HEATER
XCP TREATER
3' x 18' L.P. SEPARATOR
4' x 10' INDIRECT HEATER





Good production is preheated in the small indirect heater then flows directly into insulated separator for degassing after heating. Emulsion crude flows through large indirect heater for preheating and chemical application then into preheating coil of National XCP Treater.

Unique in this hook-up is the method used to maintain 130 degrees temperature on the storage tanks. Each of the storage tanks contains a set of vertical coils that are used as heat exchangers. Hot water flows through these coils. The water is circulated thermosiphonically between the water bath of the large indirect heater and the coils in the tanks.

This entire arrangement is so complete that it requires very little of the pumper's time, thus, releasing him to other lease duties in addition to this lease. The treating problem on this lease represented a most difficult situation because the production was foaming and because the emulsion produced from these foaming wells was finely cut and because the viscosity of the oil was very high and because the storage tanks had to be maintained at such a high temperature.

NATIONAL TANK COMPANY

TULSA, OKLAHOMA